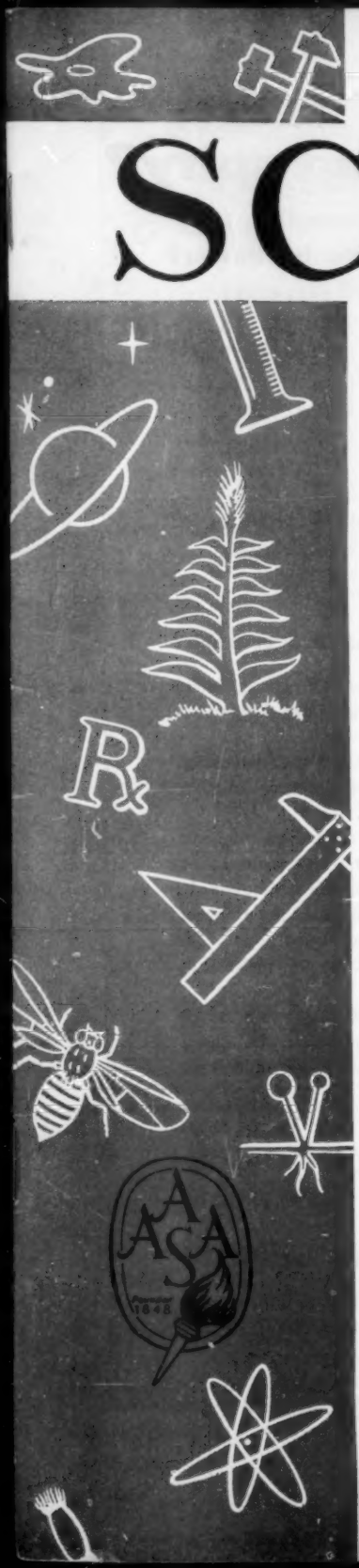

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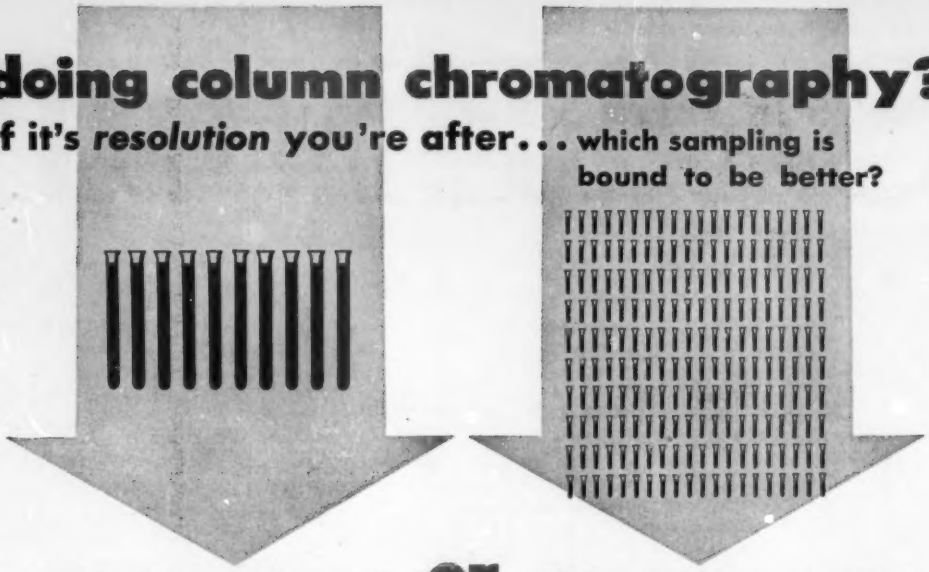

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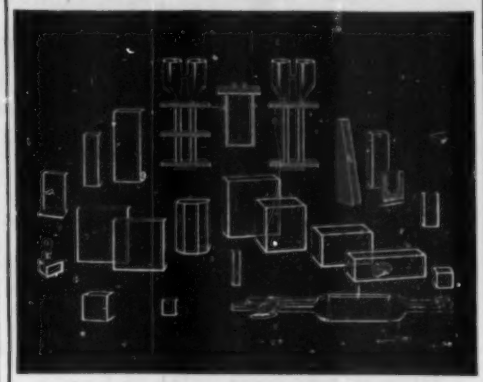

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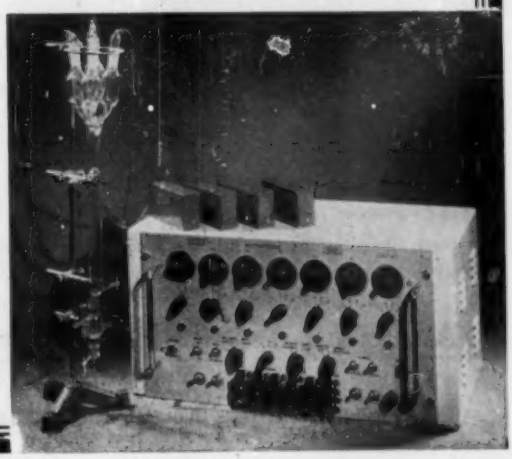

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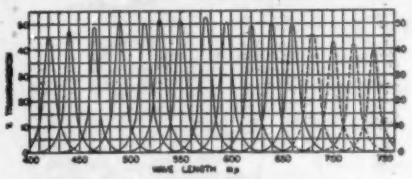

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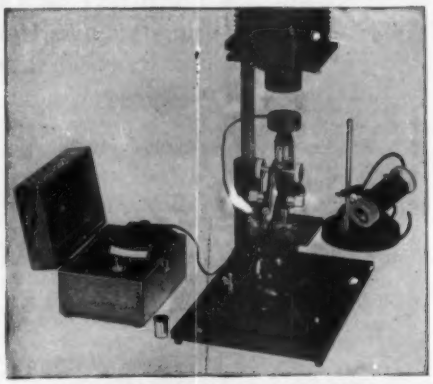

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One Scientist Speaks Up

ALBERT SCHWEITZER's appeal to the scientists to speak up "about the problem of the effects of H-bomb explosions" [*Science* 120, 11A (10 Sept. 1954)] will be heeded by many. No one will respond lightly to this challenge. Everyone will share the horrible fear of a war in which these weapons would obliterate the populations of very large areas and make uninhabitable for some time whole states or countries. Everyone also will expect the utmost precaution against further accidents resulting from tests.

Yet a distinction must be made between the threatened wartime use of nuclear bombs and the test explosions in the East and West. In the latter cases the issue is not that of wholesale destruction of lives but of the possible biological consequences slowly acting on the well-being of present and future generations. The radioactive particles that are formed during the explosions are carried high up into the atmosphere and fall out gradually over the whole globe. They surround us and are taken up by human bodies in breathing and feeding. How do they affect personal health and that of future generations?

This question, as far as it can be answered at all at present, must be answered on two different levels, an absolute and a relative one. On the basis of experience with medium and high doses of irradiation many biologists and medical men will be inclined to believe that even low dosages increase the probability of illness in individuals exposed to radioactive fall-out. For any one person the increase in probability is small indeed, but considering all mankind the production of a number of detrimental or fatal disease incidents may be expected. Likewise, most geneticists are inclined to extrapolate the evidence from medium- and high-dosage irradiation and to postulate that even very low doses produce genetic changes, mutations. Probably all will agree that many mutations are unfavorable to their carriers. Frequently the degree of detrimental action may hardly be measurable on an individual basis, although it may show a slight average effect in large numbers of individuals. This may be true even for the great class of recessive lethal mutations that kill in homozygotes but may often well be eliminated without obvious harm in the course of the generations during which they are carried in heterozygous individuals. In an absolute sense, however, it is probably true that a fraction of the induced mutations will cause future misery and death just as a fraction of the individuals of the present generation may later suffer from the direct effects of fall-out exposure.

This absolute statement has to be complemented by a relative one. In each generation of mankind many millions of individuals are born who from birth on or later in life are affected with genetically controlled slight, severe, or fatal disorders. Most of these afflictions are the expression of "spontaneous" mutations that occurred long ago and have been carried invisibly for many generations. A few afflictions are due to recent "spontaneous" mutations in one of the normal parents of the genetically ill individual. The causes of "spontaneous" mutability are varied and beyond human control: physicochemical irregularities within the germ cells, background irradiation from cosmic rays, from the natural radioisotopes of potassium and other elements, and from substances like radium.

As long as the number of test explosions remains small the total irradiation from fall-out received by an individual and his germ cells will cause only a vanishingly small fraction of the individual illnesses that afflict the present generation and an unknown fraction of the number of those mutations that originate spontaneously in each generation. Most of the induced mutations will not express themselves immediately but will appear here and there over the course of hundreds of future years. It is safe to predict that no census data will show an increase of present or future afflictions due to a carefully limited number of test explosions. Relatively then and in terms of mankind as a whole the biological consequences of controlled test explosions are very small.

The moral problem remains. Each individual case of harm or death due to fall-out, in our time or in the distant future, places a burden on our conscience. But again these cases must be weighed in a balance. We use automobiles although they are the cause of thousands of maiming and killing accidents each month. We employ x-rays although they must lead to personal damage to some and cause mutations that might produce harm in the future. We inhale industrial wastes although they may well shorten our lives. While we attempt to decrease the damage, we do not propose to abolish automobiles, x-ray machines, and chemical industry. The question of whether or not nuclear tests are of ultimate benefit to mankind is partly one of political opinion and partly one of scientific prophecy. For the political aspect the scientist's views cannot claim greater attention than those of other citizens. If the tests cause benefits the harm also done must be evaluated in relative terms. Should the tests lead to peaceful applications the gain to mankind may be greater than that from all inventions of recent centuries.

It is to mankind's shame not to have yet banished even the thought of war. Schweitzer's "anguish in my heart" must be felt by all of us. The scientists cannot cease to tell humanity the terrible truth about nuclear war, but the tests themselves pose much lesser problems.

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Science and National Security*

Lee A. DuBridge

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WE are sometimes inclined to think that the phenomenon of science being of service to the nation is a new development of recent years—say since 1940. However, science has always been a national asset and has always been in the nation's service. Science and technology have been among the decisive influences that have improved the lot of the common people and thus made this nation fine and strong.

Even in the restricted sense of science directly serving the government, rather than the people generally, we are not dealing with a new phenomenon. From the day the postage stamp was first put in general use, the United States Government has needed and has used science and technology, not only to promote the general welfare, but also to advance the special functions of the Federal Government, including the function of national defense.

This long experience has led this nation to the conclusion—a conclusion not always expressed or adequately implemented—that the government and the nation are heavily dependent for strength, welfare, and security on science and technology. Hence, the government must do two things: (i) make provision within the framework of government to carry on scientific and technologic activities directly related to specific government needs and (ii) encourage and support throughout the country a strong nongovernment science and technology. Both of these activities are necessary for a strong and prosperous nation in time of peace; both are vital to military strength in time of war.

However, it is one thing to recognize these two facts and obligations; it is quite another thing to do anything sensible about them. The history of government relations with science is replete with examples of good intention and bad implementation. A desirable agency is established and then deprived of funds. Laws enunciating high-sounding ideals are passed, and then the men who are appointed to implement them are denied secretarial help and travel funds. Scientists are saluted as being essential to the nation's progress and then are drafted as privates in the army or employed by the government under policies set up for postal clerks.

I am told that men who have been in politics for many years do not expect political institutions in a democracy to be either reasonable or consistent on any policy matter. The implementation of policy will be in the hands of many people who have differing views on various aspects of the policy, and these people will change with time; hence, there is bound to be confusion.

Those of us who are less experienced, however, still think of "the government" as an entity with a mind and a purpose. And we shall never get over the shock of seeing the government do one thing with one hand and a wholly contradictory thing with the other.

Some people react to this paradox by turning their backs on government entirely, refusing to have anything whatsoever to do with it—except when forced to serve in the Army or to pay an income tax. However, most reasonable people, although they sigh sadly at the vagaries of a democratic government, realize that it is the only government we have and try to put up with it, to help it, and even try to make it better. In time of war we all do this. In time of peace it is more difficult to do, but it is no less necessary.

It is from this point of view that I wish to discuss the question of the ways by which science and technology can contribute to making the nation strong enough in a military sense so that it can achieve its national aims and ideals in the face of opposition from potential enemies. In short, what are the ways in which science promotes national security?

This simple question does not have a simple answer. The roots of national strength extend deeply into the national pattern of living, into the nation's industrial, social, educational, and economic systems. We can not trace all these roots. But we may select a few essential items that bear on the answer to our question.

In the first place, we now understand that both a strong military and a strong industrial technology must rest on a solid base of *fundamental* science. Indeed, all technology grows out of discoveries in basic science. There are thus very practical and immediate reasons why the government should encourage the building of a strong science: (i) As I have said, new knowledge is essential to future progress. (ii) The corps of scientists engaged in basic science will be among the most able and imaginative in the country. Their numbers should increase, not only because of the scientific advances they will produce, but because they stand as a "ready reserve" available to accelerate the development of military technology when emergencies arise. (iii) Basic science in universities is the sole source of education of future scientists and technologists. The well-springs of future talent must be maintained and enlarged. (iv) Basic science in relevant fields has an important place in laboratories of applied science. It improves the intellectual tone, stimulates the imagination, satisfies the curiosity, helps attract new scientists, and, of course, fills in essential gaps in knowledge.

* Based on an address delivered at the dedication of the new building of the Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Md., on 16 Oct. 1954.

How do we stand in this area of basic science? Are we as a nation doing all right? I am convinced that the answers are in the negative. But I am also aware that there have been important forward steps during the postwar years.

First, the military services, realizing the importance of scientists to wartime technology, have aided mightily since World War II in financing a rehabilitation of university research. The funds made available for equipment, for services, and for graduate student support stimulated a spectacular postwar development in university science laboratories. We will forever owe a debt, particularly to the Office of Naval Research, for what was done in this respect. The Atomic Energy Commission, the Public Health Service, and others have made similar contributions. They have shown that government can encourage university science without the necessity of damaging political interference, provided, of course, that the universities themselves remain alert.

A second step in advance since the war is that most American industries have increased their research expenditures by an amount which, for the country as a whole, adds up to a very large factor. Industries have increased the amount of basic research in their own laboratories and have made substantial grants to support research in universities. This is excellent, and I hope the latter practice especially will greatly increase.

In the third place, the government itself, especially the military agencies and the AEC, have put their research programs on a long-term stable basis and have made provision within the government laboratories for such basic research as is appropriate and relevant in each case. I am not saying there is agreement on how much and what kind of basic research is proper or relevant in each laboratory, but I do say that the principle has been recognized.

Fourth, the Congress finally passed the National Science Foundation bill and has given it modest funds to get its program started. Its fellowship program is already an outstanding contribution.

All of these steps have helped to strengthen research, have helped in the education of students, have helped to attract young men into science, and have also brought about a degree of contact, of friendship, of understanding between the scientists and the military that was unheard of before 1941 and will be a mighty element of strength in future (and current) conflicts.

But there is much that has been left undone; much that has been done inadequately. The National Science Foundation has been treated with shameful niggardliness by the Congress, and its role and potentiality seem to be almost wholly unrecognized on the Hill. Someone on the Hill started the idea that the National Science Foundation was to "eliminate the tremendous duplication" in basic research. This is one of the most tragically mistaken delusions of recent years. Duplication in basic research is, in the first place, a contradiction of terms. Research is the seeking of new knowledge. If the knowledge has been found, no one else will seek for it—so duplication is most unlikely. If someone wishes to check up on a discovery and repeat an experiment, this is certainly not duplication. Science by definition, deals with those phenomena which anyone can duplicate at will.

Should one then say that it is duplication for two persons to be searching for the same knowledge? This is like saying that it is duplication for more than one person to search for a child lost in the woods! We all know that when many people are used the search is greatly accelerated. And so when one is searching the infinite wilderness of the unknown for an uncountable number of undiscovered pieces of knowledge, it is clearly evident that the more people engaged in the hunt, the better. And no one will find the same child twice. If two scientists happen to run onto the same discovery at the same time this is good, not bad, for it gives an immediate confirmation of the validity of the finding.

As long as science is done in the open, not in secrecy, duplication is, by the very nature of science, nonexistent. If all Congressmen could learn this one simple fact, it would make the task of the National Science Foundation much easier.

But the duplication idea leads to another illusion: Science will be more efficient or effective if it is all under one management. In order to move in this direction, the Congress, when it increased the National Science Foundation funds this year, imposed an almost equal decrease in the funds allocated to other agencies. This was most unfortunate, for it caused disruption of existing programs and a net decrease in the amount of research in progress. Furthermore, this policy ignores the fact that in science—as in education—*diversity* is our most precious asset. No single agency with a particular policy, a particular program, a particular group of advisers, a particular staff can possibly accommodate all the diverse needs of science. It is almost as bad as trying to decree that all children should have the same father!

So I suggest that in the field of basic research we have an educational job to do. We need to convince industry and the government of the value of encouraging basic research. We need to convince the executive and legislative branches of government that all agencies concerned with science and technology should encourage and support basic research, in their own laboratories and in universities; that the more agencies that are doing it, the more effective and productive our program will be; that the dividends that will be repaid in new knowledge, in more scientists trained, and in more scientists brought close to the government will be worth a thousand times the investment—and the dividend may indeed be the survival of the nation.

Let us turn now to some problems of *applied* research conducted by the government, confining our attention to research carried out for military purposes by the Department of Defense and the AEC. Applied research is in many ways a very different animal from basic research. It is true that the scientific training required is much the same and quite similar techniques

and equipment are involved. But the east-bound and west-bound sections of a streamlined train look similar too. It is just that they are not headed for the same place.

Applied research is research aimed at a goal—a better or improved weapon, a new industrial product, or a cure for a disease. Because the goal is established or agreed upon (this is important, of course!), it is possible to organize the attack on the problem, assigning a number of specific tasks or areas of investigation to different individuals or groups. Usually also it pays to avoid duplication, for it is usually less efficient to have two groups assigned to the problem of developing the same weapon than to have them combine forces. Also, since applied military research is usually necessarily secret, it is important to establish coordinating mechanisms to avoid the waste of unknowingly repeating what others have done.

For these and many other reasons it is important, when talking about government activities in science, to distinguish sharply between pure and applied science. What is good for one may not be good for the other.

Now it is not surprising to note that the military services and the AEC have developed not one but many patterns for carrying on applied research. A democracy never does anything in a unified or monolithic way. This is both our strength and our danger. The strength is that diversity of approach and individuality are conducive to new ideas. The danger is that in military research resources are scattered and ineffective, policies are confused, and high priority tasks are neglected.

It is proper that the direction of all military research has *not* been consolidated under one office in the Department of Defense, but that there has been created there one office to give guidance and coordination to all the service agencies.

It is also neither surprising nor disturbing to find the research pattern different in the three services. Yet each service needs one office that gives rather close attention to the supervision of the whole program of that service. And each service needs an effective mechanism for keeping new developments closely tied to plans, to requirements, to logistics, to tactical development. This is probably the area in which there is greatest weakness. New weapons are produced in ignorance of tactical requirements; they are introduced without adequate study of their tactical possibilities, without adequate logistics and maintenance and training. Military plans, on the other hand, are sometimes drawn up without taking into account new weapons that will shortly be available. There is inadequate attention given to clarifying the goals of the military research program and making clear to every agency its part and purpose in the program.

Many people are aware of these shortcomings, and many in the military establishment are trying to remedy them. It is not my task today, or any day, to tell them how to do the job. We certainly do wish them success.

The *mechanisms* by which military research is carried out also show great diversity, and this is both desirable and troublesome. Broadly speaking, military research may be carried on either in a government-owned and government-operated laboratory, in a government-owned contractor-operated laboratory, or in a contractor-owned contractor-operated facility. In true military style these are, I understand, called respectively: GOGO, GOCO, and COCO.

Examples of GOGO are the Naval Research Laboratory, the Army Ordnance Arsenals, the Fort Monmouth Signal Corps Laboratories, the Naval Ordnance Test Station (Inyokern), the Wright-Patterson Air Base Laboratories. In each case the facility is under the command of a military officer, and there is usually a chief civilian scientist to whom varying degrees of responsibility for the technical program may be delegated.

In the GOCO class, there are such laboratories as Los Alamos, Argonne, and, indeed, all the AEC laboratories, plus such facilities as the Jet Propulsion Laboratory operated by California Institute of Technology and the Lincoln Laboratory operated by Massachusetts Institute of Technology. In these laboratories the land, buildings, and equipment are owned by the government. However, after the general goals of the technical program have been agreed on jointly between the government and the contractor, then the contractor is given managerial responsibility for all operations. All personnel and other administrative policies are set by the contractor—usually to be in line with those he employs in other operations.

Finally in the COCO class come the great mass of contracted projects in industries and in universities. Some are small basic research projects related to a military problem. At the other extreme are vast industrial projects for development of a new airplane, a new radar, or a guided missile. Then there are establishments like the Johns Hopkins Applied Physics Laboratory and the Rand Corporation, where a privately owned facility is wholly devoted to government work—but in these cases to a broad program of applied research rather than to the building of a single device.

Now it is easy enough to classify military research centers in this way. But it is not easy to draw any general conclusions from such an exercise. It would be nice if we could say that all laboratories of one class were dismal failures, while all of another were great successes. But in human affairs things are generally not so simple. One can find examples of extremely successful and productive centers of all three kinds. One can also find members of each class that have not been as productive as could be expected.

The reason for this is not hard to find: research success is the product of good ideas; and ideas cannot be manufactured like automobiles in a production line. Ideas arise in the brains of individuals, and they arise under circumstances that no one—not even the individual himself—understands. We *do* know how to increase the *probability* of new ideas arising. There are

some simple rules for this: (i) Find some well-trained people who have been successful in getting ideas in the past. (ii) Give them full information about the nature and importance of the problem being tackled. (iii) Keep them in close touch with one another and with others engaged in similar work in a way to allow the maximum interchange of ideas, for out of such interchange and stimulation new ideas are frequently born. (iv) Provide these people with the facilities and help they need in developing and testing their ideas. (v) Keep the environment, the atmosphere, and the administrative arrangements such that there is the maximum stimulation to imaginative thought processes and the minimum of interruption and frustration.

Even these rules are not very specific. They do not tell how to find the right people, just how they are to be thrown together, what facilities they will need, or just what arrangements provide maximum stimulation and minimum frustration. All of these are delicate and subtle matters. They are also variable; a combination that works in one set of circumstances with one set of people may not work with others. Arrangements that are most satisfactory during an all-out war may prove hopelessly unsuitable in time of peace. An organization operating beautifully under one director sinks into mediocrity or worse under another. A research team that has delivered an outstanding contribution in the form of one new weapon falls to pieces when that job has been done and never quite "clicks" on another.

All of these are, as I have said, subtle and difficult problems. Their solution depends on the ability, the intuition, the adaptability, the imagination of relatively few people, possibly of only one person, in each organization. One person who can judge people, who can sense the spirit of the group, who can anticipate difficulties and avoid them, who can stimulate enthusiasm can make a successful team under almost any circumstances. And wherever you find a highly successful group I suggest that you seek the causes for its success not in the organization chart, not in the budget book, not by counting uniforms or rank but by finding a man or a small group of men who have created the spirit of the place and who know how to preserve that spirit.

If one keeps in mind the essentiality of this intangible "spirit" of a research organization, one can understand why there are so many arguments about the best way to "manage" military research. There are, in fact, many ways to "manage" it if the spirit is there. There is *no* way to manage it if the spirit is absent. From this point of view, many familiar arguments fall into proper perspective.

For example, the argument about whether it is best to have a military or a civilian director of a laboratory misses the point. A *good* military officer will clearly be better than an incompetent civilian, and vice versa. The main advantage of a civilian—assuming equal competence—is the matter of *continuity*, and continuity is very important in maintaining spirit. Also one is more *likely* to find inspired research directors among civilian scientists, because many years of experience in research is helpful in developing this innate feeling for its spirit. Experience in a fighting organization is not intended to develop this same characteristic.

Again, the arguments about the relative merits of government operation versus contractor operation now fall into perspective. The government can and does find and employ good civilians, and it has created some excellent research centers. However, the difficulties are somewhat greater. A government civil service bureau set up to employ a million clerks and secretaries may not be an efficient mechanism for employing a few hundred scientists. And a government financial system geared to a budget of 70 billion dollars may lack some of the flexibility needed for the rapidly changing needs of a research laboratory. Thus the government, in delegating research operations to a contractor, buys an important asset in this flexibility of personnel, administrative, and financial policies which a contractor may supply. And this flexibility is, in turn, an attraction to good scientists too, thus increasing the probability of finding and maintaining high-quality leadership. The objective must always be to find a mechanism that is appropriate to the task and has the greatest probability of developing and encouraging the creative spirit of research and bringing that spirit to bear on the specific military problem at hand. An able team, ably led, that understands where it is going and why will surely get there.

This brings me to a problem that I think neither scientists nor military agencies have solved. This is the problem of trying at every stage in the development and use of new weapons to bring together scientific *and* military experience. Every time an intensive effort has been made to do this in a particular area, the results have been most fruitful—sometimes spectacularly so. But this should be a *continuous* process. It seems to me that it is the responsibility of every scientist and engineer who is working within a laboratory devoted to military purposes to keep himself continuously informed of the nation's broad military problems and of the specific ones in his area. If he is working on a radar, he should inform himself fully of the military situations in which it is to be or could be used. If he is working on a missile, he should know what it is for, what other equipment it will be used with, what military problems it is intended to solve. A weapon designed in the dark, no matter how technically clever it is, may be of little or no military utility.

Conversely, of course, the military agencies have a responsibility. A weapon dreamed up as desirable by a soldier who is without access to knowledge about technologic possibilities may also be a dud—or at least less effective than it could be. The point is that military and scientific people should do their dreaming together. They should be continually exchanging ideas about problems. The scientist may hear of military situations he did not know existed, and potential aids to confronting them may come to mind. Simi-

larly the military officer, hearing about new weapon possibilities, may see new possibilities for their tactical use or how they could be adapted to new situations. The idea that the function of the military is to tell the scientists what weapons they need—and that the function of the scientists is to deliver them without argument—is as obsolete as the idea that the scientist can toss new weapons at random at the military services and expect them to find a use for them.

Weapon development is a tough business and requires the best combined talents we can muster at all stages of the enterprise. If military secrecy is interfering with this intimate meeting of minds, then secrecy is working against national security, and it is time that *real security* considerations come first.

If I were to express a hope for the future of the Johns Hopkins Applied Physics Laboratory, it would be that, as it maintains and develops the spirit of research that I have been discussing, it also becomes a meeting place where scientists and military men meet together to discuss broadly and intimately and vigorously the problems of the military defense of this country. Out of such discussions will come new and important concepts in the field of military weapons and their uses. For your business and my business is not just a better device for this or that purpose, it is, rather, nothing less than the safety of this nation. And it is your responsibility and mine—not someone else's—to insure that each of us is making his most effective contribution to that end.

New Horizons in Cancer: Cytology in Research and Practice*

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GENERALLY speaking, the early diagnosis of cancer offers the most hope for successful treatment. This doctrine has been the principal theme of efforts by the National Cancer Institute, the American Cancer Society, and other cooperating groups to improve case-finding. Educational programs to alert the public and to aid the physician in cancer diagnosis and treatment are yielding valuable dividends. Education alone, however, is not enough. Urgently needed to ease the cancer case-finding burden are practicable screening methods. An ideal solution to this problem would be a simple, inexpensive chemical or blood test as useful as the Wassermann test for syphilis. Over the years, many attempts have been made to devise a laboratory procedure that would show whether or not an individual is harboring a cancer. Altogether, hundreds of such tests have been proposed.

Since 1948 a program to evaluate the old tests and to develop new ones has been conducted, with financial and technical assistance from the National Cancer Institute, by investigators at the medical schools of Tufts College and the universities of Washington, Alabama, Tennessee, and Kansas. Much good work has been done by these and other workers in this field and reported in the literature (*1, 2*). None of the tests evaluated so far has been found sensitive and specific enough for clinical use. However, the approach seems hopeful. The fact that certain tests are effective to some extent is an indication that tangible changes do occur in the body of the cancer patient, and that these changes may be measurable in a diagnostic procedure. For instance, it is known that there are changes in the body chemistry of cancer patients. In some patients with cancer of the prostate the acid phosphatase level is increased. Measurement of prostatic acid phosphatase has been developed to the point where several laboratories are evaluating it as a means of diagnosing prostatic cancer. Other promising procedures being investigated include a serum flocculation reaction, the use of radioactive tracers, and means of detecting abnormal steroid in the blood or urine (*1*).

Although a practical general diagnostic test for cancer appears to be still in the future, considerable progress has been made in the development of tests to aid in detecting cancer of specific sites. The most useful of these is the cytologic examination developed largely by George N. Papanicolaou (*3*). In the past few years, Papanicolaou's "baby" has come of age. Today it is established as a valuable complement to other clinical procedures in early diagnosis of cancer, particularly of uterine cancer. Many qualified persons have been trained in the cytologic test, and numerous clinics and physicians in general practice are employing it routinely in cervical cancer diagnoses. Variations of the original cytologic technique have been developed to aid in the detection of cancer of the lung (*4*) and of gastric cancer (*5*). These variations show considerable promise when used in combination with other procedures. Cytology is being evaluated as a screening test for cancer of the genitourinary tract, the rectum, and the colon. Also under study are applications of the cytologic examination to breast secretions and spinal fluid.

The value of vaginal cytology as a detector of early

cervical cancer has been indicated in many clinical investigations (*6*). One of the most recent studies concerned more than 5000 women who received cytologic examinations by private physicians (*7*). The study reported that the examinations had revealed 48 definitely curable asymptomatic cervical cancers. The study also pointed out the economic feasibility of this screening procedure, estimating that its cost per private case is within the keeping of many other laboratory procedures.

Cytology provides not only a means of detecting cervical cancer in its incipiency but also material for study of the development of the disease. Research of this type is underway which may answer questions that bear directly on the problem of controlling uterine cancer, questions such as: Do the intraepithelial or "early" cancers progress invariably to invasiveness? How frequent is "early" cervical cancer? How many of these cancers regress spontaneously?

A number of studies seeking the answers to these questions have yielded significant preliminary findings. The University of Tennessee College of Medicine, with the support of the National Cancer Institute and other groups, is applying vaginal cytology in a mass-screening survey for uterine cancer and intraepithelial cancer among 165,000 women in Memphis and Shelby County, Tennessee.

The results obtained in the screening of the first 70,000 women are very encouraging. The cytology findings were suspicious or positive in 1327, or 1.9 percent, of the women. Tissue biopsy studies have been completed in 1076 of the 1327 cases. The biopsy diagnoses were positive in 51 percent of the cases; borderline, suspicious, or inconclusive in 15 percent; and negative in 34 percent. Vaginal cytology resulted in false positives in only 369 cases, or one-half of 1 percent, of the 70,000 women screened. From the point of view of cancer control, it is especially significant that 88 percent of the 282 confirmed cases of intraepithelial cancer of the cervix were unsuspected prior to cytology, and 29 percent of the 245 confirmed cases of invasive uterine cancer were unsuspected.

Also of particular interest is the age distribution of these cancers among the cases screened in the Memphis cytology study. On the average, the women with intraepithelial cancer are about 20 years younger than the women with invasive uterine cancer. The median age of the women with early cervical cancer is 33, while the median age of those with invasive cancer is 52. This suggests that preinvasive lesions are present for a long enough time to allow for their eradication.

The Memphis study was begun in July 1952. Cytologic examinations of the women will be repeated at yearly intervals, and the study will be continued until the incidence of intraepithelial cancer and its relationship to the incidence of invasive uterine cancer are determined.

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* Based on an address before the Southern Society of Cancer Cytology in St. Louis, Mo., 8 Nov. 1954.

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News and Notes

Events Related to Differentiation of Cells

A conference on *Molecular Events in Differentiation Related to Specificity of Cell Type* was held under the auspices of the New York Academy of Sciences at the Barbizon Plaza Hotel in New York, 8–9 Oct. Among the many informative papers given was one by J. D. Ebert *et al.* (Indiana) who reported: (i) The major synthesis of cardiac myosin is initiated during formation of the primitive streak; this protein can first be detected (by immunological methods) at the midstreak stage; (ii) in the definitive primitive streak stage embryonic cardiac myosin is distributed throughout the ectoderm; it has not been detected in the entoderm; (iii) the restriction in distribution of cardiac myosin coincides with the initiation of synthesis of at least one antigen of the cardiac actin complex, which is already limited in distribution to the heart-forming areas at the time it is first detected. C. L. Markert (Michigan) recounted the use of various substrates for melanogenesis in tissue culture, including C^{14}-labeled tyrosine, dopa, tryptophan, glucose, glycine, and unidentified oxidation products of tyrosine. Of these, only uniformly labeled tyrosine and its oxidation products were differentially incorporated into melanin granules as shown by autoradiograms. He reported that since tyrosine with a C^{14} in the side chain did not serve as a melanin precursor, doubt is cast upon the generally accepted scheme for melanogenesis. C. E. Wilde, Jr., (Pennsylvania) reported that the differentiation of the cells of the Urodela neural crest in tissue culture appears to be controlled by a special metabolism concerned with phenylalanine

or tyrosine. Of particular interest was his report of specific inhibition of pigmentation and pigment cell differentiation by a hydroxyl-substituted phenylalanine compound. C. Grobstein (NIH), culturing mechanically fragmented chick and mouse embryos, concluded that there is a stage in the origin of nervous tissue when the presumptive area has sufficient stability to continue neuralization when isolated without disruption, but during which the component cells have not been stabilized, or possibly even biased, as to type.

Other significant papers presented were those by L. B. Flexner (Pennsylvania) on "Events associated with the differentiation of nerve and hepatic cells"; E. W. Caspari (Wesleyan) on "The role of genes and cytoplasmic particles in differentiation"; G. W. Nace (Duke) on "Development in the presence of antibodies"; M. Spiegel (Cal. Tech.) on "The reaggregation of dissociated sponge cells"; A. M. Schechtman (California) on "The nucleus of the cell and cellular differentiation"; A. G. Karczmar (Sterling-Winthrop) on "Limb regeneration and 'overt behavior' differentiation in urodeles as studied by means of their response to chemical agents"; and S. M. Rose (Illinois) on "Specific inhibition in growth and differentiation."

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Science News

A National Science Foundation **survey of scientific publications** indicates that 70 percent of all papers submitted to editors are eventually published in the journals to which they are submitted; a considerable portion of the remainder are rejected because they have been submitted to the wrong journal. Delays in publication varied from more than 1 yr to less than 6 mo. Average delay was 5.3 mo for journals publishing 500 pp or less per year and 1.9 mo for journals publishing more than 2000 pp per year. Delay in journals in which the average article ran 4 pp or less was 5.6 mo compared with 2.1 for journals in which the average article was 20 pp or more.

The most important **advances and trends** in science and technology during 1954 as picked by Watson Davis, director of Science Service, are (i) conversion of atomic energy radiation directly into electricity, and the development and application of solar batteries turning sunlight into electricity; (ii) demonstration of photosynthesis by nonliving green grains extracted from plant cells, and the elucidation of the role of complex sugars and phosphorus in the photosynthetic process; (iii) mass trials of a vaccine against polio upon 1.5 million school children; (iv) "Pogo" fighter plane that takes off straight up and lands tail-first; (v) use of naturally radioactive tritium to trace age of water in rain and elsewhere; (vi) structure of the center of the Milky Way, our own stellar galaxy, revealed by radio waves generated by the hydrogen gas filling space between the stars; (vi) rising apprehension that radioactive material from atomic and H-bombs will poison the earth's atmosphere and affect the continuance of human life; (viii) discovery that corn is at least 60,000 yr old and native to the Western Hemisphere; (ix) revoking of the security clearance of J. Robert Oppenheimer and similar cases that affected adversely the relationships of scientists to government; (x) the successful use of the international language, Interlingua, for abstracts at world medical meetings and in scientific journals.

In an effort to **destroy the screwworm**, which annually causes millions of dollars in losses, U.S. Department of Agriculture scientists are working with Dutch authorities on the Caribbean island of Curaçao. Since the female mates only once a year and with only one male, research workers released thousands of males made sterile by exposure to gamma rays from radioactive cobalt. It is anticipated that the screwworm population will be smaller next year.

Silicon crystals with a lifetime of more than 0.001 sec have been produced in the General Electric Research Laboratory at Schenectady, N.Y.; the usual lifetime of silicon is a few ten thousandths of a second, often considerably less. The "zone melting" process was used. An ingot of high-quality silicon was drawn through a long gas-filled quartz tube. Induction coils melted the element in narrow zones. Impurities remained in the high temperature zone and were swept to the end of the tube, leaving the silicon—thought to be the purest produced to date.

Calcutta monkey dealers are protesting an order of the Indian government that bans trapping or exporting monkeys between 1 Apr. and 31 Aug. They point out that America already imports 3000–4000 monkeys every year from Manila.

Edward A. Suchman, Robin M. Williams, and Rose K. Goldsen, all of Cornell University's department of sociology and anthropology, are conducting a **study of the "values" of foreign students** at the university—how such values differ from those of American students, what kind of American friends the foreign students have, how they evaluate their experiences in the United States, and how their values and attitudes may change as a result of their stay here. Suspecting that their association and friendships with American students are important in determining the visitors' reactions during their sojourn here, the sociologists will focus attention on the friendship formation between American and foreign students. The study complements two other research projects centered at Cornell, one on student values in 11 American universities, and one on intergroup relations in five American cities.

The Social Science Research Council is sponsoring this project and parallel investigations at three other universities—New York University, the University of California, and the University of Michigan. It has also sponsored smaller, intensive studies of foreign stu-

dents at the University of Wisconsin, the University of Pennylvania, Ohio State University, and the University of California.

A new kind of high-voltage machine, a **modified van de Graaff generator,** was reported in the 4 Dec. issue of *Nature* by R. E. D. Clark of the Cambridgeshire Technical College and F. T. Farmer of the Royal Victoria Infirmary, Newcastle-upon-Tyne. Instead of carrying electrostatic charges on its moving belt, it carries charged capacitors that are automatically connected in series as they reach the top of the machine. This increases current output and voltage.

The **European rabbit,** one of the worst of animal pests, is being introduced into the United States by sportsmen. Some have already lived through one mild winter in northern Pennsylvania. They are being imported from the San Juan Islands, off the coast of Washington, where colonies have existed for many years.

Missouri has long served as a supplier of native cottontail rabbits for stocking purposes in other states. This practice was recently halted, thus facilitating the development of the San Juan rabbit supplying business. The menace of this creature is so well recognized that a Federal law banning its importation was enacted more than 50 yr ago, although interstate shipment is apparently legal.

Few pests have been more dramatically publicized than the European rabbit; it has devastated large areas in Australia and New Zealand. Damage that it causes amounts to many millions of dollars a year, and control efforts have been costly and largely futile. Myxomatosis recently has reduced numbers in Australia and Europe, but immune strains are already developing. This disease cannot be counted on for lasting control, and there is reason to think it might be ineffective in America. Recent reports on the European rabbit situation may be found in *Ohio Conservation Bulletin* for Aug. 1954, *Pennsylvania Game News* for Sept., and *Science News Letter* for 13 Nov.

In line with the London and Paris agreements permitting **West Germany to resume nuclear research** and to produce fissionable material on a limited scale, an atomic law is being drawn up by the Federal Government of West Germany. Its primary aim is to prevent misuse of products and to guard against any radioactive dangers threatening the health of the population.

Germany's future stock of nuclear fuels, from its own production as well as from imports, shall not exceed 3500 gr at any time or in any year. This is seven times the amount originally envisaged by the now defunct EDC treaty. As specified in the agreements, such nuclear fuels include plutonium, uranium-233, and uranium-235.

Together with the drawing up of the atomic bill, plans are being developed for the construction of a 10,000-kw reactor. The reactor is primarily to serve research purposes and its costs are estimated at DM. 20 million. It will be located in either Munich or Karlsruhe. In this connection the Society for the Study of Physics was recently founded; its members consist of 16 firms interested in nuclear development.

In preliminary studies made at the University of Illinois by R. P. Link and Jean C. Smith of the college of veterinary medicine, it was found that atabrine purged infected dogs of two species of **tapeworm.** Of 12 dogs treated, 91 percent were free of *Taenia pisiformis* and 85 percent were free of *Dipylidium caninum* within 23 days of the initial treatment. However the drug was not effective in curing the infection of two other parasites, *Ancylostoma canium* and *Toxocara canis.* Previous findings by other scientists have shown that atabrine has been effective in ridding human beings and mice of tapeworm infections.

Scientists in the News

Edward U. Condon released the following statement when he resigned recently as director of research for the Corning Glass Works.

> On July 12, 1954, after a full hearing and after consideration during more than three months, the Eastern Industrial Personnel Security Board decided that I was entitled to full clearance for access to classified information in connection with the work of Corning Glass Works for the military departments. My clearance was reported in the press for the first time on Oct. 19, 1954. On Oct. 21, 1954, the secretary of the Navy, Charles Thomas, announced that he had asked the Board to reconsider its decision and had suspended my clearance.
>
> At the present time I do not feel there is any possibility of my securing a fair and independent judgment in a reconsideration of the decision by the Eastern Industrial Personnel Security Board of last July in favor of my security clearance. This Board had before it the reports of investigations stretching over eleven to fourteen years, since I worked on highly secret defense problems for the Government over a period from 1940 to 1951. In the course of that period, I have been cleared by such agencies as the Manhattan Project, the full membership of the Atomic Energy Commission, the Department of Commerce, and the military departments.
>
> I now am unwilling to continue a potentially indefinite series of reviews and re-reviews. I have therefore withdrawn my application for clearance, with the satisfaction that an objective and unbiased board which has conducted a complete hearing in this matter, which is also the highest board established by the three military departments for this purpose, has, after hearing me and studying the full record, decided that I am entitled to full clearance.
>
> I have served my Government in its efforts to preserve our national security for many years in both public and private capacities, and with a considerable degree of success if the testimony of my fellow scientists, available to the present authorities in this proceeding, is to be believed. In the course of these services my loyalty to this country and its Government has been clearly and formally established, and

these proceedings raise no question on this score. If the duly constituted authorities of Government ever desire or request my services, they will be available and I will undergo any security examination and comply with any security procedures.

I am happy to say that throughout all this difficulty the management of Corning Glass Works has shown confidence in me and my ability, and a willingness to support me in every procedural step to have my clearance re-established.

The long-drawn-out clearance difficulties, however, began to affect my ability to perform my duties efficiently, and even to impair my health, so I began to consider other possibilities of employment. Aside from this, I have long felt a desire to get back entirely to fundamental research in physics.

Corning Glass Works showed an understanding of this problem and has agreed to a solution whereby I will be able to devote my energies to a long-range program of fundamental research on the structure and properties of glass. I expect to establish my home at Berkeley, Calif., where I shall engage in research on special assignments from the company, as well as in other private scientific research.

William H. Armistead, manager of the melting department of Corning's research and development division since June, has succeeded Condon. The company has also named **Harry R. Kiehl** associate director of research. He formerly was assistant to the research director and manager of the physics department.

Vannevar Bush, retiring president of Carnegie Institution of Washington, received the annual $1000 William Procter prize awarded by the Scientific Research Society of America. The award, given for general scientific achievement, was presented 30 Dec. at the 121st AAAS meeting in Berkeley, Calif. In his acceptance address Bush said:

> . . . Indeed it is a grim world and the future for the moment looks dark. . . . But do we need to be glum about it at all? . . . It is no new thing for man to confront perils in his upward struggle. Life has always been hazardous, civilization has always been threatened, our individual deaths have always been an inevitable certainty. But men have faced uncertain futures before with courage. . . . We are privileged to share together in a great adventure, the very hazards of which should draw us closer together. With determination and wisdom our sorry old world may yet become a happy place to live in, where wars are no more, and where the spirit of brotherhood dominates all we think and do.

Donald J. Portman, for the past 5 yr a staff assistant in micrometeorologic research at Johns Hopkins University, has accepted an appointment as a physicist for Beckman and Whitley, Inc., San Carlos, Calif., manufacturer of high-speed research cameras and thermal and meteorologic instruments.

William S. Boyd, professor emeritus at the universities of Toronto and British Columbia, will be visiting professor of pathology at Ohio State University in January. Boyd is the author of numerous pathology textbooks.

John Christian Warner, president of Carnegie Institute of Technology, has been chosen president-elect of the American Chemical Society. **Joel H. Hildebrand** of the University of California was elected president for 1955. Warner directed and coordinated research on the purification of plutonium during World War II.

Libbie Henrietta Hyman of the American Museum of Natural History has been named by the National Academy of Sciences to receive the Daniel Giraud Elliot medal, which is awarded annually in recognition of meritorious work in zoology or paleontology. Hyman won the award for her treatise *The Invertebrates.* The medal and accompanying honorarium will be presented at the 92nd annual meeting of the academy 25–27 Apr. 1955.

Stanley Cobb, neuropsychiatrist and Bullard professor emeritus of neuropathology at Harvard Medical School, delivered the fifth annual Leopold Stieglitz lecture at New York University College of Medicine on 15 Dec. The lecture, "Multiple etiology in psychiatry and medicine," was given in conjunction with Cobb's 1-mo stay at N.Y.U. under the **Leopold Stieglitz** visiting professorship. This professorship was established with funds provided by friends and patients of Dr. Stieglitz, who at 86 is in his 63rd year of general practice under the State Board of Regents medical license No. 1.

Max Tischler, director of process research and development at Merck and Co., Inc., Rahway, N.J. is to succeed **Per K. Frolich** as vice president for scientific activities of the chemical division. Frolich has resigned to accept the top civilian scientific post in the Army Chemical Corps. Tischler received the Merck Board of Directors scientific award in 1951, an award that has provided for the Max Tischler lectures in chemistry at Harvard University and the Max Tischler scholarship fund at Tufts College.

Gunnar Pleijel, Institute of Technology in Stockholm, an expert on natural radiation and solar energy, has arrived in the United States on a fellowship from the Sweden-America Foundation. Pleijel plans to discuss research in his field with scientists at more than 50 American universities and institutions.

Edwin M. McMillan, a Nobel prize winner and professor of physics at the University of California, has been named faculty research lecturer for 1954–55. The selection is made by the university's academic senate, which annually selects one of its members for this honor. The lecture is given in March. McMillan was cited by the academic senate committee for his discovery, with P. H. Abelson, of neptunium, his participation in the discovery of plutonium, and for his proposal of a theory that increased the power of atomic particle accelerators in the period following World War II. McMillan was recently appointed by President Eisenhower to the General Advisory Committee of the Atomic Energy Commission.

Frederick J. Martin, for the past 8 yr a physical chemist with the M. W. Kellogg Co., Jersey City, N.J., has accepted an appointment as a research associate in the chemistry research department of the General Electric Research Laboratory, Schenectady, N.Y.

The Carnegie Institution of Washington has announced the election of **Caryl P. Haskins**, New York, as its president. Haskins, president and director of research of the Haskins Laboratories, a nonprofit scientific and educational foundation that he established 18 yr ago, will take office 1 Jan. 1956 upon the retirement of **Vannevar Bush**. During World War II Haskins served with the National Defense Research Committee and the Office of Scientific Research and Development. Since the war, he has acted as a consultant to the departments of Defense and State.

John F. Harris, lieutenant-colonel, U.S. Army, has received the Maj. Louis Livingston Seaman award from the Association of Military Surgeons for his article, "The military surgeon," that appeared in the association's journal. He is the first Negro doctor ever to be so honored in the history of the association.

Cedric Beebe, formerly in charge of the physical analytical laboratory of the Koppers Co., Pittsburgh, has joined the staff of the application engineering group of the Liston-Becker Instrument Co., Inc., Springdale, Conn.

Necrology

Crosby F. Baker, 67, chairman of the chemistry department of Tufts College, Medford, Mass., 9 Dec.; **Joseph D. Evans**, 79, electrical engineer and munitions expert, Lowell, Mass., 10 Dec.; **Jacob A. Goldberg**, 64, social hygienist and author, New York, 12 Dec.; **Mark H. Haller**, 57, research horticulturist with the U.S. Dept. of Agriculture, Beltsville, Md., 1 Dec.; **Robert L. Kelly**, 89, educator, author, and former president of the Association of American Colleges, Claremont, Calif., 12 Dec.; **Frank A. Kittredge**, 71, retired chief engineer for the National Park Service, Palo Alto, Calif., 10 Dec.; **Mario G. Levi**, 76, president of the Italian Chemistry Association, Milan, 9 Dec.; **George J. Peirce**, 87, past president of the Botanical Society of America and professor emeritus of botany and plant physiology, Stanford University, Calif., 15 Oct.; **Philip S. Rosenblum**, 60, medical director and chief of urology of the Eastern Division of the Albert Einstein Medical Center, Philadelphia, 12 Dec.; **J. Melbourne Shortliffe**, 75, retired chairman of the department of economics at Colgate University, Hamilton, N.Y., 13 Dec.; **Olof Sjöqvist**, 53, head of the neurosurgical division at the St. Erik Hospital, Stockholm, 4 Dec.; **Plumer Wheeler**, 78, former superintendent of the engineering department of the American Cyanamid Co., Linden, N.J., 12 Dec.; **John H. Wurdack**, 66, head of the department of chemistry at the University of Pittsburgh School of Pharmacy, Pittsburgh, 8 Dec.

Meetings

The influence of the therapist's own personality upon a therapeutic situation was considered in the first of two papers presented at the 2nd annual meeting of the **Southern California Psychiatric Society** held recently in Los Angeles. The paper, "Our values system in psychotherapy," was read by C. H. Hardin Branch, professor and head of the psychiatry department of the University of Utah. Norman Reider, head of the psychiatry department, Mount Zion Hospital, San Francisco, presented the second paper, "Demonology in modern psychiatry."

A symposium on the **Science of Soil Stabilization** will be held on 12 Jan., as a part of the 34th annual meeting of the Highway Research Board of the National Research Council. Sponsored by the committee on physicochemical phenomena in soils under the chairmanship of Hans F. Winterkorn, Princeton University, the symposium will present or summarize 11 papers by scientists from the U.S., Kenya, Mozambique, England, French Equatorial Africa, and West Germany. These papers with a few additional papers that will be presented at the business meeting of the committee are to be issued as a printed volume.

More than 3000 public health workers attended the **82nd annual meeting of the American Public Health Association** and 38 related organizations held recently in Buffalo, N.Y. A foreign delegation was headed by M. G. Candau, director general of the World Health Organization and Rajkumari Amrit Kaur, minister of health for India and president of the 3rd World Health Assembly. Topics of special interest were smoking and lung cancer; infectious hepatitis; newly discovered respiratory viruses; and developments in such health areas as air pollution, child accident prevention, and food sanitation. A two-session symposium, open to all delegates, considered the impact of suburbanization on public health. Officers for 1954–55 are pres. H. E. Hilleboe, New York State Commissioner of Health; pres.-elect, I. V. Hiscock, professor and head of the department of preventive medicine, Yale University.

Some physiological aspects and consequences of parasitism will be the theme of the 11th annual **conference on protein metabolism** to be held under the sponsorship of the Rutgers University Bureau of Biological Research on 28 and 29 Jan. Leslie A. Stauber, professor of zoology at Rutgers, will open the conference. William Trager, Rockefeller Institute for Medical Research, will discuss "Studies on the cultivation of intracellular parasites," and James W. Moulder, University of Chicago, will speak on "The protein metabolism of intracellular parasites." Other speakers and their subjects are as follows: Clark P. Read, Johns Hopkins School of Hygiene and Public Health, "The host-parasite relationship"; Ernest Bueding, Louisiana State University, "Glycolytic enzymes"; W. H. Taliaferro, University of Chicago,

"Studies in antibody formation;" and L. A. Stauber, "Leishmaniasis and metabolism of the host." Nearly 200 scientists from the nation's laboratories are expected to attend.

Education

In connection with the 25th anniversary of the dedication of the **University of Chicago's George Herbert Jones Laboratory**, which was observed in December, the Julius Steiglitz memorial lecture was presented by Paul D. Bartlett, department of chemistry, Harvard University. His subject was the stereochemistry of rings. John G. Kirkwood, department of chemistry, Yale University, delivered the William Draper Harkins lecture on the structure of the liquid state. The university's 263rd convocation further highlighted the celebration and featured an address by Willard F. Libby of the Atomic Energy Commission. The anniversary observance was jointly sponsored by the university's department of chemistry and the Chicago section of the American Chemical Society.

Two continuation **courses in chemistry** are being offered during the winter and spring of 1955 by the chemical education committee of the American Chemical Society, Philadelphia Section, at the Philadelphia College of Pharmacy and Science. An 11-wk course in "Recent progress in organic chemistry" is scheduled to begin 7 Feb. 1955 and a 10-wk course in "Patent law for chemists" opens on 8 Feb. 1955. Information can be obtained from Dr. Paul E. Machemer, Committee Chairman, Dept. of Chemistry, Villanova University, Villanova, Pa.

The recent announcement that the U.S.S.R. "is currently turning out twice as many scientists and engiers as the United States" helped prompt the Carnegie Corp. to grant $20,000 to Massachusetts Institute of Technology for the purpose of studying **Soviet advances in scientific and engineering education.** Carnegie officials, in announcing the grant, explained that the Soviet advantage over the U.S. in these fields "gives an added urgency to the study." At the same time the corporation granted an additional $1,261,000 to other institutions for varied projects in research.

George P. Berry, dean of the faculty of medicine of the **Harvard Medical School,** recently announced the establishment of a new professorship to be known as the **Samuel A. Levine** professorship of medicine. The endowment has been provided by Charles E. Merrill, New York investment banker, who made an initial gift of $400,000 and asked that the professorship be named for Levine, who is clinical professor of medicine at Harvard and a member of the staff of Peter Bent Brigham Hospital as well as other medical institutions. In making the announcement, Berry said that the Levine professorship "would be devoted for the foreseeable future to the study and treatment of heart conditions and cardiovascular diseases."

Available Fellowships and Awards

Daniel and Florence Guggenheim jet propulsion fellowships will be awarded for graduate study at Princeton University and California Institute of Technology in the jet propulsion centers established in those universities by the Daniel and Florence Guggenheim Foundation. Fellowships carry a stipend ranging from $1200 to $2000 annually, as well as tuition, for study toward advanced degrees. The purpose of these fellowships is to select and train outstanding men for basic research and for leadership in the development of rockets and jet propulsion, with particular emphasis on peacetime uses.

The fellowships are open to those having suitable engineering or scientific undergraduate preparation. Candidates must have outstanding technical ability, demonstrated leadership qualities, and deep interest in rockets and jet propulsion. *Applications must be received by 1 Mar. 1955*; they will be acted upon by 1 Apr. For applications and information, address the foundation at 120 Broadway, New York 5.

Michigan State College offers ten Graduate Council fellowships for predoctoral study for the year 1955–56. Each carries a stipend of $700 payable in nine monthly installments, as well as a waiver of course and tuition fees. Every application for a fellowship must be complete, and every applicant must have been admitted to the School of Graduate Studies, *before 1 Mar. 1955*. Further information may be obtained from the Dean of the School of Graduate Studies, Michigan State College, East Lansing, Mich.

The University of Hawaii fellowships in Pacific science were instituted at the time that the university, Yale University, and the Bishop Museum embarked on the Tri-Institutional Pacific Program. One **University of Hawaii fellowship** in the amount of $4000 is awarded every year. *The application deadline is 1 Mar.* Preference is given to applicants working in the social sciences. Applications should be addressed to the Dean of Faculties, University of Hawaii, Honolulu. Stewart Cameron, a lecturer in the geography department of Auckland University College, New Zealand, has been granted the 1954 fellowship for a 1-yr study of the forests of Western Samoa.

In addition, Yale and the Bishop Museum have agreed to support one research fellowship each, awarded by Yale and known as the **Yale-Bishop Museum fellowships.** These fellowships also are for $4000 and applications must be submitted to the Dean of the Graduate School, Yale University, New Haven, Conn., by *1 Mar.* Preference is given to applicants who plan to work in the biological sciences.

The 1954 Yale-Bishop Museum fellowships have been awarded to Ichizo Nishiyama of Kihara Institute of Biological Research, University of Kyoto, and to H. S. Shirakawa of the University of Notre Dame. Nishiyama plans a study of the cytogenetics of cultivated sugar canes in the Pacific region and will work

at the Experiment Station of the Hawaiian Sugar Planters' Association in Honolulu. Shirakawa is to work in the Hawaiian Islands on fungal leaf parasites of Hawaiian plants.

Grants and Fellowships Awarded

The Biological Sciences Division of the **Office of Naval Research,** Department of the Navy, has awarded the following research contracts to universities and nonprofit research institutions for periods of from 1 to 3 yr.

Biology

University of Hawaii, Honolulu. P. B. van Weel. Digestive physiology of marine animals in relation to coral reef destruction.

University of Maryland. Hugh G. Gauch. Mass culture of unicellular algae.

Marine Biological Laboratory, Woods Hole, Mass. Philip B. Armstrong. Studies in marine biology.

Scripps Institution of Oceanography, University of California, La Jolla. Martin W. Johnson. Marine wood boring organisms.

University of California, Santa Barbara. Demorest Davenport. Behavior and specificity in marine symbioses.

Scripps Institution of Oceanography, University of California, La Jolla. Theodore J. Walker. Studies of Biological mechanism of obstacle detection.

Bermuda Biological Station for Research, St. George's. Talbot H. Waterman. Nutrition, feeding, and physiology of deep sea animals.

University of Delaware. R. R. Ronkin. Energetics of ciliary motion.

University of Southern California. W. E. Martin. Marine organisms producing swimmer's itch.

Duke University. J. G. Pratt. Studies of orientation in animals.

State College of Washington. Donald S. Farner. Studies of photoperiodic influence on animals.

University of California, Santa Barbara. J. E. Cushing, Jr. Immunology of marine animals.

University of Miami, Coral Gables. Charles Lane. General biology of marine borers.

University of Wisconsin. A. D. Hasler. Mass movement of fish.

Marine Biological Laboratory, Woods Hole, Mass. William E. Schevill. Underwater biologic noise.

National Research Council, National Academy of Sciences, Washington, D.C. Paul Weiss. An international conference of marine biological laboratory directors.

Haskins Laboratories, New York. Luigi Provasoli. Factors determining growth in marine algae and protozoa.

University of Michigan. Henry van der Schalie. Studies of organisms related to the vector of the disease schistosomiases.

Microbiology

University of Tennessee. J. M. Woodward. The effect of bacterium tularense on animal hosts.

University of Maryland, School of Medicine. Edward Steers. The metabolism of purines.

University of Pittsburgh. Max Lauffer. Biophysical investigations on bacteriophages.

University of Kansas. Cora M. Downs. Pathogenesis and immunity in tularemia.

University of North Carolina, Raleigh. M. L. Speck. Study of certain growth stimulants for lactic acid bacteria.

University of North Carolina, Chapel Hill. Milton Huppert. Study of yeast infections following antibiotic therapy.

Iowa State College of Agriculture and Mechanic Arts. F. G. Smith. Preservation of spores of puccinia by lyophilization.

Massachusetts Memorial Hospitals. Louis Weinstein. Production of immune substances in living bodies.

Yale University. Helen Simpson Vishniac. Research in marine fungi.

University of Utah. Stanley Marcus. Laboratory diagnosis, treatment and resistance in systemic myotic infection.

George Washington University. P. K. Smith. Possible inhibitors in the virus-host relationship.

State University of Iowa. Albert P. McKee. The role of complement in the body.

University of Minnesota. H. C. Lichstein. Enzymic factors concerned with the virulence of certain bacterial species.

University of Illinois. H. O. Halvorson. The mechanism of heat resistance of bacterial spores.

University of Pennsylvania School of Medicine. Harry E. Morton. Studies on pleuropneumonia-like organisms.

Hahnemann Medical College. B. A. Briody. Study of variation in viruses.

Reed College. Ralph W. Macy. Studies on animal parasites.

University of Illinois. H. H. Thornberry. Factors influencing plant virus infections.

Indiana University. W. J. van Wagtendonk. Role of steroids in the metabolism of microorganisms.

University of Texas. J. W. Foster. Spore formation and germination in bacteria.

University of Colorado School of Medicine. J. Carroll Bell. The effects of chemical compounds on the tubercle bacillus.

Yale University. D. Weinman. Transmission and epidemiology of toxoplasmosis.

University of New Mexico. R. B. Johnson. Isolation, purification, and testing of bacterial somatic antigens.

State Unviersity of Iowa. R. E. Kallio. Production and purification of clostridial collagenase.

University of Texas. Orville Wyss. Variation in the genus azotobacter.

State College of Washington. Torbjorn Moll. Concurrent effect between virus and bacteria in enteric infections.

Colorado A & M College. N. R. Gerhold. Spore dispersal patterns of plant pathogens.

Tulane University School of Medicine. Morris F. Shaffer. Antigenic and cultural properties of nocardia.

University of California, Berkeley. S. S. Elberg. Trace elements and bacterial virulence.

University of Pittsburgh. Horace M. Gezon. The effect of antibiotics on shigella organisms.

University of Chicago. Edward D. Garber. The nature of resistance and susceptibility to infectious agents.

University of Miami, South Miami. Murray Sanders. Propagation of animal viruses in marine embryonic cells.

Colorado A & M College. J. J. Lehman. Use of metabolites in the reactivation of microorganisms.

University of Texas Medical Branch. C. M. Pomerat. Studies on cellular mechanisms in relation to body defenses.

Louisiana State University. R. J. Strawinski. Microbial oxidation of hydrocarbon gases.

Columbia University. S. P. Halbert. The relationship of a bacterial toxin to the pathogenesis of rheumatic fever.

Long Island Biological Association, Inc. M. Demerec. Microbial resistance to chemical and physical agents.

Loyola University School of Medicine, Chicago. Rolf Freter. Experimental enteric infections of laboratory animals.

University of Chicago. C. Phillip Miller. Role of the intestinal microflora in resistance to enteric infections.

George Washington University. L. W. Parr. Factors involved in resistance to and recovery from shigellosis.

Johns Hopkins University School of Hygiene and Public Health. W. H. Price. Certain disease agents and their insect vectors.

Physiology

Cornell University. E. Sheppard and I. S. Wright. Electrostatic forces in blood.

University of Illinois. W. J. Fry. Effects of ultrasound on nerve tissue.

Johns Hopkins University. R. L. Riley. Instrumentation and research on pulmonary function.

Duke University. K. E. Penrod. Mechanism of oxygen toxicity.

National Institutes of Health, Bethesda, Md. H. Specht. Respiratory function in underwater swimmers.

Massachusetts Institute of Technology. F. O. Schmitt. Composition and properties of nerve proteins.

University of Washington. A. A. Ward. Experimental concussion.

Wayne University. E. D. Gardner. Study of certain pathways in the nervous system.

Indiana University. A. W. Richardson. Biological effects of microwave irradiation.

Brown University. R. Truell. Biological effects of ultrasound.

Tulane University. R. T. Nieset. Physical and physiological factors in the biological effects of microwaves.

University of Pennsylvania. H. P. Schwan. Influence of ultra high-frequency electromagnetic radiation on biological material.

George Washington University. H. Bacchus and C. E. Leese. Ascorbic acid and adrenal cortex relationships.

University of Illinois, Chicago. S. R. Rosenthal. A study of perfusates of thermally injured skin.

New York University. R. Soberman. Determination of basic differences in edema of various pathologic origins.

University of Pennsylvania. G. M. Austin. Investigation of neurophysiological properties of the human spinal cord.

Medical College of Virginia. E. C. Hoff. Cerebral regulation of the autonomic nervous system.

University of Minnesota. N. Lifson. Development of technique to measure total carbon dioxide output by use of doubly labeled body water.

Georgetown University. L. H. Kyle. Use of specific gravity method to study body joints.

University of Michigan. S. T. Dempster. Study of the coordinated action of muscles on body joints.

Management and Marketing Research Corporation. C. Wilson and L. E. Morehouse. Measurement of accelerative forces on bodies in aircraft accidents.

University of California, Berkeley. N. Pace. Physiological properties of intracellular components.

University of Maryland, Baltimore. R. G. Grenell. Effects of anoxia on neuronal structure and function.

University of Wisconsin. J. N. Williams. Effects of enzyme activity on animal tissues.

Syracuse University. V. J. Wulff. Electrophysiology of the visual pathway.

University of Alberta. J. C. Opsahl. Pituitary and adrenal-hyaluronidase relationships.

Yale University. J. M. R. Delgado. Neurological mechanisms in anoxia and epilepsy.

University of North Carolina. A. T. Miller. Influence of body type and composition on work capacity and thermal regulation.

University of Pennsylvania. J. D. Hardy. Effects of thermal radiation on skin.

University of Pennsylvania. J. D. Hardy. Thermal radiation and thermal stress.

University of California, Berkeley. S. F. Cook Effects of prolonged exposure to high altitudes on growth and metabolism.

University of Pennsylvania. H. P. Schwan. Electrical and mechanical properties of biological materials.

Naval Radiological Defense Laboratory, San Francisco. E. L. Alpen. Symposium on thermal injury.

Cornell Unviersity, New York. H. H. Hasbrook. Crash injury research.

Miscellaneous

Among the articles that appear in the January issue of *The Scientific Monthly* are the following three papers that were read before the symposium on *Organism and Machine*: "Direction of processes in living systems" by Wolfgang Köhler; "Is the concept of an organism as a machine a useful one?" by N. Rashevsky; and "Mysterium iniquitatis of sinful man aspiring into the place of God" by Warren S. McCulloch.

Additional articles featured in *The Scientific Monthly* for January are "Flames," Herbert P. Broida and Harold J. Morowitz; "Acceptance of science," Alan T. Waterman; "Some problems in large-scale culture of algae," Harold W. Milner; "Nutrient supply for large-scale algal cultures," Robert W. Krauss; "The transistor as an industrial research episode," Ralph Bown; "Facts, thoughts, and dreams," J. A. Gengerelli; and "Validity of test items that involve finding a pattern in data," Richard H. Lampkin. The papers by Milner and Krauss were presented at the Boston meeting of the AAAS as a part of the symposium on *Uses of Large-Scale Algal Cultures*. In the "Science on the march" section, there is an article by Betty Appleton on "LOBUND comes of age." This issue also contains 22 book reviews.

Marvin C. Meyer of the department of zoology, University of Maine, Orono, has announced that after considerable searching a copy in Russian of **Waldimir D. Selensky's** *Etudes Morphologiques et Systématiques sur les Hirudinées: I. L'Organisation des Ichthyobdellides* (Petrograd, 1915), was finally located abroad. A photostatic copy was obtained and a complete English translation of the text has been made. Museum and university librarians interested in obtaining a copy of this translation, complete with text, figures, and plates, should write to Dr. Meyer.

Selensky, who at the time of his death in 1931 was head of the parasitology department at the University of Leningrad, was one of the leading zoologists in Russia. His researches were devoted chiefly to the morphology, biology, and systematics of leeches, the most important contribution being the volume mentioned here.

Proceedings of the First Conference on Training Personnel for the Computing Machine Field is now available for $5 per copy from the Wayne University Press, Detroit 1, Mich. The volume consists of some 35 papers relating to educational and manpower problems brought about by the emergence of the automatic computer. As a result of extensive investigations, perhaps for the first time some idea of the magnitude of the manpower requirements at the various levels of competence was obtained. Basic questions dealing with educational practices and objectives are discussed at length and with considerable unanimity.

The following **chemicals** are wanted by the Registry of Rare Chemicals, Armour Research Foundation of Illinois Institute of Technology, 35 W. 33 St., Chicago 16: aluminum nitride; silver hyponitrite; sodium telluride; phosphonium iodide; diethylgermanium iodide; 1,4-cyclohexanediamine; anthracene-9,10-dicarboxylic acid; 2-chlorocyclopentene-1; 7-nitrohydrindene; 2,3,5,6-tetramethylbenzoic acid; 2,5-dihydroxyphenylalanine; 2,4,2′,4′-tetrahydroxydiphenyl; 2,3-dichlorobenzyl alcohol; epifluorohydrin; 10-methyl-1,2-benzanthracene; β-chlorolactic acid; murexine; tangeretin; nobiletin; muscarine.

The American Institute of Chemical Engineers, 25 W. 45th St., New York 36, has announced a new publication, the ***A.I.Ch.E. Journal***. For the first year the *Journal* will be a quarterly, but eventually it is to become a bimonthly or monthly. The publication will be devoted to research results based on new data; new devices, tools, instruments for research, development, and design; new theoretical and statistical methods; new correlation; process design, kinetics, thermodynamics, and so forth; research projects in allied branches of engineering, chemistry, and physics; and topics of general value to educators and researchers. Harding Bliss of the Chemical Engineering Department of Yale University has accepted the editorship. The first issue will be released in March. A member-subscription is $4.50; non-member, $9.

Book Reviews

Textbook of Electrochemistry. G. Kortüm and J. O'M. Bockris. Elsevier, Houston–Amsterdam, 1951. vol. I, 352 pp. $7; vol. II, 544 pp. $10.

The appearance of an English edition of Kortüm's *Lehrbuch der Elektrochemie* is indeed a welcome event, for the widespread application of electrochemical methods in the chemical and biological sciences during the postwar period has made the need for a work of this character greater than ever before. It is also a pleasure to note that the masterly organization and presentation of the subject matter in the original German text has been retained in an idiomatic and concise translation. A comparison with the original shows, however, that considerably more than merely a faithful translation has been achieved. Not only is there evidence of critical revision, particularly in the chapter on the essentials of chemical thermodynamics, but two entirely new chapters have been added which, respectively, give a detailed account of experimental methods and present numerous useful tables of physicochemical quantities relevant to electrochemistry. In addition, a list of problems, graded in difficulty, together with solutions and explanatory notes, has been supplied to adapt the book for use by university students. The final result, which brings together in two volumes a lucid exposition of fundamentals, a comprehensive summary of modern electrochemistry, and a tabulation of up-to-date reference material, will appeal especially to research workers. Those who desire to gain an introduction to electrochemistry by means of self-study will also find this excellent textbook well adapted for such a purpose.

The enlargement of the scope of the book so that two volumes are now required has led, however, to difficulties in the division of the subject matter and in the indexing which are perhaps not ideally resolved. Thus, the average student who may not want or feel able to buy the complete work, unfortunately, may also be reluctant to buy the first volume, since both the index and the illustrative problems that go with it are in the second volume. This possible defect could easily be remedied by including the relevant problems and index in the first volume, thereby increasing the present 350-page length to only approximately 430 pages at most.

The copy is relatively free from errors, typographic or otherwise. Some readers, however, may find amusement in the discussion of redox systems (p. 305) in which a German bear has become an Irish bull: "In cells of this type it is immaterial whether the oxidizing agent is added to the cell, or *vice versa*." Certain other differences in terminology and convention may give pause to the American audience for this book. Thus (p. 75) the constant pressure, Gibbs free energy G, is termed: "the free heat content." More important, perhaps, is that the European convention for the sign of the electrode potential was preserved in the translation. Of course, this convention need not be a source of confusion on this side of the Atlantic, provided that a consistent formalism is followed in the writing of the cell equations.

In the second volume the more advanced, specialized topics of electric phenomena at interfaces, irreversible electrode processes, and the electrochemistry of gases have received relatively greater attention than in previous electrochemical textbooks, in keeping with the important developments in this branch of the subject during the past decade. The second of these chapters, 88 pages, is especially noteworthy. In the future, doubtless an exposition of the thermodynamics of irreversible processes will supply a foundation for the discussion of many of the transport processes in electrochemistry. It also seems probable that many of the discussions of electrokinetic phenomena may then be treated in a coherent and quantitative fashion .

G. E. Boyd

Oak Ridge National Laboratory

Introduction to Opinion and Attitude Measurement. H. H. Remmers. Harper, New York, 1954. viii + 437 pp. $5.

As a comprehensive survey of the attitude measurement field, this book has a good deal to recommend it. It at least touches on nearly every phase of the field and treats some subjects in considerable detail.

The first section is devoted to the techniques of measurement, with chapters on sampling, statistics, scaling, and questioning techniques. The second section is concerned with applications of opinion and attitude measurement to business, government, education, and the community.

According to the publisher's statement, "this is, we believe, the first suitable textbook prepared for college courses in the subject." While I can think of one or two other textbook candidates, the fact remains that Remmers has written a thorough and inclusive introduction to the theory and practice of attitude measurement.

A book that attempts to cover an entire field in the space of a few hundred pages inevitably suffers from some shortcomings. One is a tendency to move from one subject to another with a minimum of delay. Thus question wording, one of the crucial phases of opinion measurement, is disposed of in about five pages. Another weakness is the occasional introduction of terms and concepts without thorough explanation of them. In general, the chapters on sampling, statistics, and scaling are quite good, but they do employ terminology and concepts that will be difficult for the beginning student to master, particularly for one without a statistical background.

Finally, the attempt to cover everything in the field has resulted in a mass of briefly summarized studies, particularly in the "applications" section of the book.

It is quite difficult to retain, digest, and extract the significance of these many studies. The brief summaries at the end of each chapter do not accomplish this function.

The foregoing are minor flaws, however, in an otherwise commendable book. On the positive side, the author's thorough treatment of the technical and difficult subject of scale analysis, his chapter on the applications of attitude measurement to industry, and his review of indirect methods of measurement are excellent.

Extensive bibliographies at the end of each chapter are helpful for those interested in a more detailed exploration of the subjects treated.

W. DONALD RUGG

Opinion Research Corporation

Ion Transport across Membranes. Papers presented at a symposium at the College of Physicians and Surgeons, Columbia University, Oct. 1953. Hans T. Clarke, Ed.; David Nachmansohn, Assoc. Ed. Academic Press, New York, 1954. xi + 298 pp. Illus. $7.50.

The papers presented at a symposium on *The Role of Proteins in Ion Transport across Membranes* are collected in this volume, together with six other contributions. In the first paper, Ussing gives a useful summary of the results of ion transport studies. In the second paper, by Hodgkin, electric processes in nerve conduction are described for the benefit of physicists and chemists rather than for physiologists. The summary is a highly abridged version of the explanations offered by the author for the relationship between membrane potential changes and transfers of Na^+ and K^+. "The generation of bioelectric potentials" is the title of a paper by Wilson and Nachmansohn, and this, perhaps more appropriately entitled "Studies on acetylcholine," contains the well-known views of these authors. Friess, Blum, and Morales, in an interesting note, show that a reacting mixture of ACh and its esterase has a greater ultraviolet absorption than the sum of its components, and that light-scattering measurements fail to demonstrate a change in the shape of the protein when it interacts with ACh.

Parpart and Hoffman in "Ion permeability of the red cell" provide an up-to-date summary of the various problems existing in this field. A paper by Mudge on "Renal mechanisms in electrolyte transport" contains much interesting material, especially at the cellular and histochemical level. Two very interesting theoretical contributions follow, the first by Parlin and Eyring on "Permeability and electric potential" and the second on "Transport of ions through biological membranes from the standpoint of irreversible thermodynamics" by Kirkwood. The use of ion-exchange membranes to secure electrodes where neither oxidation nor reduction takes place is discussed by Scatchard and also by Sollner, Dray, Grim, and Neihof. These latter authors also present a large amount of experimental data on collodion and other types of membranes. A paper by Hill, "Theory of protein solutions," is an application of statistical-mechanical considerations to the thermodynamic properties of protein solutions. "The interaction of proteins and ions, with special reference to mercury derivatives of mercaptalbumin," by Edsall, "The specificity of metal-protein interactions," by Gurd, and "Equilibrium and sedimentation of uncharged particles in inhomogeneous electric fields," by Debye, complete the volume.

By way of general comment, although the contributions are all of high quality, there seems little homogeneity to the subject matter of the volume. The original title of the symposium has been dropped as a title for this volume, presumably because none of the contributions deal with this problem; indeed, it has not been possible to connect proteins with the transport of sodium or potassium ions. Only four papers out of 14 deal with ion transport from an experimental point of view, two papers deal with theoretical problems in ion transport, and the rest are contributions to protein chemistry or high polymer chemistry.

L. J. MULLINS

Biophysical Laboratory, Purdue University

Histopathologic Technic and Practical Histochemistry. Rev. ed. of *Histopathologic Technic.* R. D. Lillie. Blakiston, New York, 1954. ix + 501 pp. $7.50.

This is a very personal book, in which a distinguished and able pathologist makes available to his fellow-workers the methods that he has found helpful or interesting during his many years of experience. The author has been a pioneer in the application of histochemical procedures for the study of pathologic tissue. His interest in histochemistry has been largely within the realm of those reactions that can be applied to sections or tissues on a slide rather than in exploitation of fragmentation and differential centrifugation methods or microchemistry of a test-tube nature applied to tiny tissue fragments or sections.

Within his chosen area Lillie has included many methods useful for localizing compounds, groups, or enzymes in tissue sections. These are presented more or less in cook-book fashion, each accompanied by a brief statement of the author's evaluation of and experience with the method and by adequate bibliographic references. The extensive citing of histochemical procedures is a feature of this new edition, which preserves from the previous edition the presentation of numerous methods for staining, fixing, sectioning, injecting, or otherwise preparing tissue for microscopic examination. The result is an impressive collection of methods, each presented in the light of Lillie's personal experience.

Useful features included at the end are tables of formulas, buffers, acids, and other data helpful in preparing solutions used in the methods cited. Perhaps useful for beginners is the opening chapter, dealing with Lillie's practices in using the microscope, although this section is not altogether sound from the

viewpoint of optical theory. In general, however, the author's experience and thoughts, as embodied and compiled in the methods presented here, will probably be useful both to beginners and to experienced workers seeking to gain information about tissues with the light microscope.

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Tables Numériques de Physique Nucléaire. Charles Noël Martin. Gauthier-Villars, Paris, 1954. 258 pp. Paper, $5.15; cloth, $6.79.

This book contains 14 tables. The first six are tabulations in various forms of a semiempirical mass formula due to Weizsäcker and modified later by several authors. Similar tables calculated by computing machines under the direction of Metropolis and Reitwiesner were published by the Atomic Energy Commission, as Report NP 1980, several years ago. I do not know whether they are still available.

Tables 7 to 14, with the exception of Table 11, contain simple functions that are easily calculable on a slide rule: for example, $r_0A^{1/3}$ as a function of A with r_0 constant. Table 11, Gamow penetration factors, is useful in several problems, especially of alpha decay, and cannot be calculated immediately on a slide rule.

The author's introduction contains the statement: "All calculations were hand made without using any machine for it is my opinion that mistakes are statistically less numerous when using mental arithmetic than when striking keys of a machine and transcribing the figures." This goes a long way in explaining the contents of a good part of the book. It is doubtful whether people not sharing the author's opinion on calculating machines will have much use for a large portion of the tables.

The typographic presentation is excellent.

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Organic Chemistry. Lawrence H. Amundsen. Holt, New York, 1954. xii + 368 pp. Illus. $4.75.

This textbook is designed for a one-semester course in elementary organic chemistry and, as such, is necessarily limited in scope. In common with many elementary text books, the primary emphasis is on aliphatic chemistry; aliphatics are followed by brief treatments of amino acids and proteins, carbohydrates, carbocyclic aromatics, heterocyclic compounds, and a concluding chapter dealing with natural products. A group of simple exercises at the end of each chapter is essentially a guide to the student in assimilating the contents.

It should be possible, even in a brief treatment, to show that organic chemistry is magnificently systematized, rests on clarifying theoretical foundations, and is a fascinating field. This has not been achieved. Great stress is placed on nomenclature. A large number of syntheses and structures are tabulated with little elaboration and no theoretical considerations, and much weight is given to industrial processes, sometimes resulting in misleading implications about typical reactivities of classes of organic molecules.

Many students who elect a one-semester course in organic chemistry may never again have formal contact with an experimental science. It would seem of primary importance to use this opportunity to further their understanding of the scientific method. This book, with its dry statements of fact, throws little light upon the development of ideas. However, it is liberally sprinkled with discussions of the practical aspects of organic chemistry, photographs, and drawings. And, if the purpose of a short course for nonchemists is to provide some familiarity with names of compounds, with structures, with reactions, and with industrial processes, this treatment will serve.

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Residual Stresses in Metals and Metal Construction. William R. Osgood, Ed. Reinhold, New York, 1954. xii + 363 pp. Illus. $10.

This book, prepared under the guidance of the Committee on Residual Stresses of the National Research Council, is comprised of 22 papers dealing with the present state of knowledge on the effects of residual stresses upon the flow and fracture of metals. The book concludes with an exceptionally good summary, based on the statements made in the papers as well as the opinions of the members of the committee. The conclusions reached are as follows.

1) So long as the behavior at any point in a body is elastic, residual stresses superpose with any other state of applied stress. However, if yielding occurs, the residual stresses are relieved and will have no pronounced effect on the performance of a structure. When plastic flow is restrained, as for example, under conditions of triaxial stressing, residual stresses combine with the load stresses.

2) It is recognized that high reaction stresses in welded structures result in high levels of latent energy. However, the influence of latent energy on the failure of structures is still unknown.

3) The presence of the right type of residual stresses is beneficial for structures subjected to fatigue loadings.

4) Residual stresses may assist in the initiation of brittle fractures in ships and affect adversely the fatigue strength of ship steel. The effect of residual stresses on the propagation of ship fractures is less clear; but unless spontaneous fractures can be explained in the absence of residual stresses, these stresses cannot be considered as unimportant.

Recommendations for further research, both in the various papers and in the summary, emphasize that there is still considerable work required before the effects of residual stresses on the behavior of structures will be fully understood.

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Molecular Theory of Gases and Liquids. Joseph O. Hirschfelder, Charles F. Curtiss, and R. Byron Bird. Wiley, New York; Chapman & Hall, London, 1954. xxvi + 1219 pp. Illus. $20.

This truly gigantic volume has grown out of studies undertaken in a program sponsored by the Navy Bureau of Ordnance in the University of Wisconsin Naval Research Laboratory. The various chapters were originally issued as University of Wisconsin Naval Research Laboratory reports. It is an outgrowth of a National Defense Research Committee report on the thermodynamic properties of propellant gases. Some chapters or sections were prepared with the assistance of J. de Boer (Amsterdam), C. A. Boyd (Wisconsin), H. B. Palmer (Wisconsin), J. S. Rowlinson (Manchester), and E. L. Spotz (Wisconsin).

The volume consists of three parts. After an introductory chapter, Chapters 2 to 6 describe equilibrium properties in the following order: the statistical background; the equation of state of gases at low and moderate densities; the equation of state of dense gases and liquids; vapor-liquid equilibria and critical phenomena; the influence of quantum mechanics on the equation of state. Part II (Chapters 7–11) discusses nonequilibrium properties: the kinetic theory of dilute gases; transport phenomena of dilute gases; the transport properties of dense gases and liquids; the quantum mechanical theory of transport phenomena; hydrodynamic applications of the equations of change. In this last chapter such topics as energy transfer by radiation, sound propagation, formation of shock waves, flame propagation, shock wave propagation, detonation, and the flow of propellant gases in rockets are discussed. The last part is devoted to intermolecular forces: Chapter 12 discusses the electromagnetic basis of intermolecular forces; Chapter 13 shows how intermolecular forces can be derived by various methods; Chapter 14 discusses specific cases. A long appendix giving 32 tables and the usual indexes conclude this book.

There is no doubt in my mind that this volume will be consulted time and again by workers in the field and will be used as a standard reference. The authors can be congratulated on compiling and critically sorting out such a huge amount of data.

There are, almost naturally, some minor points on which I do not see eye to eye with the authors. They are purely minor criticisms and do not diminish my admiration for this scholarly and stimulating book from which I, for one, hope to draw research problems for some time to come.

I do not think that this book can be used as a textbook, notwithstanding the inclusion of problems. The style does not lend itself for such use because it still smacks of reports to the Navy. I regretted the use of petit ensembles in Chapter 3 for the derivation of the equation of state; de Boer, for instance, has shown how much more naturally the use of grand ensembles is in this case. The book unfortunately is not very critical in that it often gives two or more different methods for arriving at a result without clearly giving a preference for one of them—a preference that one would expect from the authors in view of their extensive experience. The title is slightly misleading, since the bulk of the text deals with gases and only small parts with liquids. This is, of course, no fault of the authors, for liquids are very badly understood. However, since liquids are treated mainly as dense gases, the inclusion of liquids in the title is slightly ambitious. The many references to reports to ONR and so on, which are not readily available to European readers should, in my opinion, have been avoided. Finally, although I can see the inevitability, the practically exclusive use of Lennard-Jones potentials is rather disappointing, inasmuch as the authors show in the last part of the book that the repulsive part of the intermolecular potential is exponential rather than of the Lennard-Jones form. However, the Wisconsin group has lately considered the so-called "Buckingham (6-exp) potential," so that a future edition of this volume will probably no longer see this extreme preponderance of the Lennard-Jones potential.

The high price of the book probably could not have been avoided, but I feel that a page size of 6½ by 9¼, instead of 4¼ by 7¼, which would have reduced the volume to about 650 pages, would have led to a book easier to handle than the present rather bulky volume.

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Peripheral Circulation in Man. A Ciba Foundation Symposium. G. E. W. Wolstenholme and Jessie S. Freeman, Eds. Little, Brown, Boston, 1954. xi + 219 pp. Illus. + plates. $6.

This volume contains the papers and discussions of a symposium of international scope held in London in May 1953. Topics and contributors have been carefully selected, and as a consequence this book provides a fitting complement to its companion volume, *Visceral Circulation*, which appeared in 1953.

Of the 18 scientific papers included in *Peripheral Circulation*, the first four, which comprise more than one-fourth of the book, are devoted to current methods of studying peripheral blood flow. Highlighting this group is A. C. Burton's critical survey of methods applicable to human beings. Subsequent articles deal with such currently important topics as the secretion and action of adrenalin and noradrenalin, peripheral circulatory responses to heat and cold, innervation and reflex control of cutaneous vessels, and peripheral circulatory responses to sympathectomy. Concluding the volume is a series of authoritative clinical contributions dealing with alterations in the vascular system during peripheral ischemia, the significance of cold hemagglutinins, and the influence of visceral distension upon peripheral circulation in the spinal man.

It is not the purpose of this review to discuss individual papers. Three or four suffer from a complete lack of supporting data; another loses much of its effectiveness through amazingly awkward phraseol-

ogy. The majority, however, are excellent contributions. Discussions are for the most part informative and stimulating, and the carefully selected references and extensive author and subject indexes add to the general utility of the book. Considered as a whole, *Peripheral Circulation in Man* can be recommended as a valuable source of up-to-date information for all who are interested in the physiological or clinical aspects of the subject.

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A Curriculum for Schools of Medical Technology. Israel Davidsohn, Ed. Registry of Medical Technologists, American Society of Clinical Pathologists, Muncie, Ind., ed. 3, 1953. 122 pp. Illus. Paper, $3.

Intended as an outline of a curriculum for the training of medical technologists and as a guide to the technologist who wishes to review the basic work and new techniques, this manual has been completely rewritten and brought up to date. The preceding edition appeared more than a decade ago.

New Books

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Los Hidro-Metabolitos y las "Enfermedades de la Civilizacion." P. Puig. Libreria Editorial, Argos, S.A., Barcelona–Buenos Aires, 1954. 325 pp. Paper, P. 100.

Fundamentals of Electrical Engineering. Based on the rationalized M.K.S. system of units. Edward Hughes. Longmans, Green, London–New York, 1954. 470 pp. $2.50.

Modern Chemical Discoveries. Richard Clements. Dutton, New York, 1954. 290 pp. $5.

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Needed Research in Health and Medical Care. A biosocial approach. Cecil G. Sheps and Eugene E. Taylor. Univ. of North Carolina Press, Chapel Hill, 1954. 216 pp. $5.

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Technical Papers

Phreatic Floor Slot in Model Cave, Nevada

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Scour troughs, or floor slots as they are commonly called, are of frequent occurrence in limestone caves. They are found incised into both the clay and the bedrock of cave floors; in some cases, because of the solvent power of the generating waters, they are more likely to have excavated the limestone rather than the unconsolidated sediments.

Fidlar (*1*) and Malott (*2*) describe types of floor slots generated by gravity streams in the caves near Marengo, Ind., and numerous other descriptions can be found in the cave literature. Both Davis (*3*) and Bretz (*4*) in their studies on cave origin summarize many occurrences of the feature. Bretz accepts such floor slots as reliable evidence for the former presence of gravity streams that invaded caverns that for the most part had been previously excavated under phreatic or sub-water-table conditions. All the floor slots that have thus far come to my attention resemble in their behavior the familiar scour troughs of surface streams, and all travel consistently downgrade.

I wish to introduce a different type of floor slot—one that does not follow a consistent downhill course but rather rises and descends with the undulations of the floor of the cave passage. It occurs in Model Cave, situated on the east slope of the Snake Range, White Pine County, Nevada, within 2 mi of Lehman Caves National Monument. The slot emerges from beneath the water-table pools at the deepest point in the cave (approximately 2000 ft from the entrance) and pursues a winding course throughout the extent of the cave, dividing where the passage divides and climbing where it rises. The passage and the slot, by means of a series of roller-coasterlike undulations, finally attain the elevation of the entrance and former point of discharge, fully 100 ft above the innermost source. A short abandoned *thalweg* connects the cave entrance with perennial Baker Creek, and it was by this anomalous tributary that the cave was first discovered. Although the slot is occasionally obscured by silt and debris, it is for the most part conspicuously carved into the stratified floor deposits consisting of mud, sand, gravel, cobbles, bone, and charcoal.

Cross sections of the passage and the slot were measured at intervals averaging 5 ft through the length of the cave; and by examining these, it was observed that the slot is deeper and narrower where the passage is more constricted. For example, the slot is 1 ft wide and 1 ft deep where the passage cross section is 12 ft^2; and where the passage measures 150 ft^2, the slot is 8 ft wide and only 2 to 3 in. deep. Such a relationship is expected if we assume that the slot was generated by the current in a filled conduit carrying a corrasive load: maximum velocity and, hence, greatest cutting power would be developed in the zones of smallest cross-sectional area.

No apparent relationship is found between the dimensions of the slot and the slope of the floor. The slot transects both sand bars occurring at the crests of the rises and gravel deposits trapped in the troughs. In the mapped portion of the cave, the maximum upward gradient that the current had to overcome is 25 deg; maximum down-slope, 45 deg. Even steeper slopes are known in the unmapped regions. The serpentine path of the slot appears to be determined by the locus of the apex of the ceiling, to which it corresponds, except where deflected by bedrock. Eddies have locally generated potholes in the sand of its walls and floor. Solution flutes in the marble of the ceiling occur throughout the length of the passage and possess slip-off slopes consistently oriented toward the mouth of the cave, thus indicating flow in that direction. Similarly, asymmetric ripple marks in the floor sands have their steep faces directed toward the cave mouth. Both of these features are accompanied by sand bars and imbricated pebbles oriented in the same direction. All these phenomena are reliable indicators of flow upward along the passage in the manner of the limestone artesian channels of Fuller (*5*), the "sub-water-table streams" of Bretz (*4*), and the pressure channels (Druckleitungen) of the European scholars (*6*).

A period of submerged solution of the marble along two limbs of a syncline was evidently followed by episodes of gravel deposition and quiet silting. During the latter, many portions of the cave became filled with mud, remnants of which still exist. All these deposits have been dissected by the floor slot, which, in turn, has become covered with a thin veneer of recent mud derived from the presently fluctuating water body observed at the far end of the cave. Because of its rising course, the slot could not have been generated by a conventional gravity stream, but rather it must represent excavation under conditions of phreatic flow. It is suggested that the slot represents the track along which the bottom load of this current was dragged during the final period of scouring.

From the foregoing discussion it is concluded that floor slots in caves should not be accepted indiscriminantly as criterions of vadose conditions. Undoubtedly other similar artesian conduits containing floor slots have been entered in other localities; but unless the investigator had the good fortune to be the first to enter them, the chances are that the subtle flow indicators and the slot itself had been obliterated by previous explorers.

The initial studies of Model Cave were conducted as part of the field program of the Western Speleological Institute and were sponsored by O. H. Truman. Completion of the survey of this somber but

highly instructive cave hinges on the behavior of the water table that controls the depth to which one may penetrate.

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9 September 1954.

Pyretogenic Effect of Lysergic Acid Diethylamide

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Whereas most of the ergot alkaloids exhibit oxytocic or peripheral autonomic effects, lysergic acid diethylamide (LSD) shows little or none of these actions but rather a hallucinogenic effect (*1, 2*). In studying the effects of LSD in intact normal rabbits marked hyperpnea was noted. This led to a consideration of the possibility of the existence of increased body temperature, which was indeed found to be the case (*3*).

Most experiments were carried out on unanesthetized and otherwise untreated animals. The agent was supplied in ampuls containing 0.1 mg/ml and was administered either subcutaneously or intravenously without dilution. No significant difference was observed in the amount of the fever, but the time of onset and duration of action were somewhat shortened with the intravenous route of administration. A rise in rectal temperature was produced in rabbits, dogs, and cats, but the rabbit was most markedly affected and, hence, was used for certain subsequent experiments. Subcutaneous injections of 50 μg/kg of LSD in the rabbit produced a rise in rectal temperature within 10 to 20 min. The peak effect was reached after 2 to 4 hr. The total duration of the pyretogenic action was 7 to 9 hr.

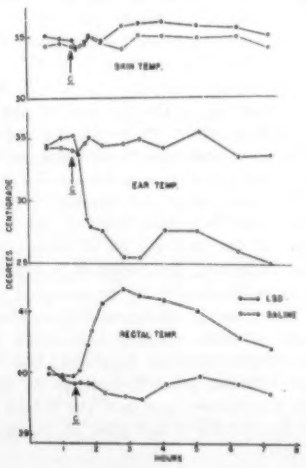

Fig. 1. Skin, ear, and rectal temperatures of a rabbit receiving 50 μg/kg of LSD subcutaneously and a control rabbit receiving an equivalent volume of saline.

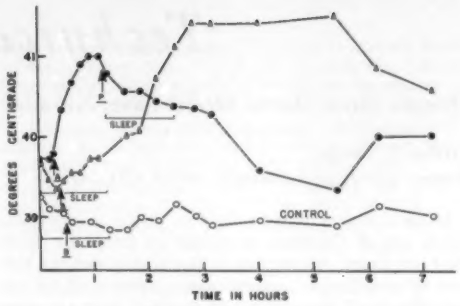

Fig. 2. Effect of the administration of anesthetic doses of sodium pentobarbital of 30 mg/kg intravenously on the pyretogenic effect of 50 μg/kg LSD administered intravenously. In the curve indicated by triangles the pentobarbital was given at the height of the LSD effect. The lower curve is the rectal temperature of a control rabbit receiving pentobarbital only. Sleep indicates the period during which righting reflex was absent.

Preliminary experiments were carried out in an attempt to clarify the mechanism of the pyretogenic action. In addition to rectal temperature, surface temperature of the skin and the ear was measured by a McKesson's model 205 Dermalor in several rabbits. The skin temperature was measured from a shaved area approximately 4 in.^{2} on the back of the rabbit. Figure 1 is a typical response from such as experiment. Skin temperature did not change significantly from that of a control rabbit, but the ear temperature fell markedly. This latter effect persisted throughout and far beyond the pyretogenic effect. This led to a consideration of the possibility that the rise in rectal temperature might be due to a vasoconstriction of the rabbit ear preventing radiation and raising the internal temperature. To test the role of the rabbit ears in the control of body temperature, the ears of a normal rabbit were clamped with hemostats. There was no change in rectal temperature during a period of 6 hr. Hence it is not likely that the pyretogenic effect of LSD is the result of this vascular effect.

Attempts were made to lower the LSD-produced fever by the administration of antipyrine, dihydroergotamine. Hydergine, and dibenamine. These were without effect. Sodium pentobarbital administered intravenously in doses of 30 mg/kg did affect the LSD-induced fever. Figure 2 shows this marked antagonism. Previous administration of this dose of sodium pentobarbital prevented the pyretogenic response of LSD for as long as the animal was anesthetized. Administration of this dose of pentobarbital at the height

of the temperature rise reduced the fever and restored the temperature to approximately normal.

Reports of the action of LSD in intact animals and human beings have been conflicting and undependable. Forrer and Goldner (*2*) report that two of five patients showed a slight rise in oral temperature after LSD. Reports of other actions of LSD on the cardiovascular system (*2*), central nervous system (*4*), and autonomic system (*5*) are likewise variable and equivocal. The pyretogenic effects reported here are reproducible and dependable, and so there is a possibility of taking advantage of this effect as an end-point in the investigation of the pharmacology of LSD. On the one hand, this effect may be part of the predominant central action. On the other hand, it may be simply a side action of this agent unconnected with its predominant central nervous system effects. Studies are being continued to determine the mechanism of this pyretogenic effect of LSD and to explore its usefulness in general pharmacologic studies of this agent.

Conclusions. Lysergic acid diethylamide produces a rise in body temperature of normal rabbits, cats, and dogs. This rise in temperature is antagonized by the administration of sodium pentobarbital but not by antipyrine or adrenergic blocking agents.

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19 July 1954.

Studies on *Pasteurella pestis* in Fleas: II. Experimental Blocking of *Xenopsylla cheopis* with an Avirulent Strain of *P. pestis*

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The classical findings (*1*) that fleas blocked with a proventricular mass of *Pasteurella pestis* were particularly significant plague vectors have been confirmed by numerous investigators (*2*). Nevertheless, to account for certain epidemiologic phenomena, some workers have suggested, without direct evidence, that the bacteria may undergo a loss of virulence in the flea (*3*). On the other hand, it is generally assumed that virulence of the plague bacillus cannot be increased in the flea. Nothing appears to be known about the fate of a completely avirulent strain of *P. pestis* in the flea. It is this problem that forms the basis for the preliminary observations reported here.

The development of an apparatus for the artificial feeding of fleas (*4*) made it possible to exert a high degree of control upon the number of bacteria ingested by the flea and to provide an efficient *modus operandi* for infecting fleas with avirulent plague strains. Thus by means of *in vitro* feeding of fleas, the oriental rat flea, *Xenopsylla cheopis*, could be given blood meals containing *P. pestis*. The data presented in Table 1 show the quantitative transfer of avirulent *P. pestis* strain A1122 (*5*) from the heparinized blood meal in the feeding apparatus to the flea. After infection, the fleas were maintained on white rats and removed when desired.

As was demonstrated by bacteriologic cultures, the plague bacilli multiplied rapidly after the first day in the ventriculus of the flea (Fig. 1). In the five female fleas that were macerated and plated out 2 days after infection, the bacteria count ranged from 1.1 to 6.0 million viable plague bacilli and averaged 3.0 million. In the five male fleas the range was from less than 5000 to more than 350,000, the average, 2.2×10^5 and the median, 2.6×10^5. The medians observed on any particular day did not represent as much as a twofold difference from either the averages or the actual bacterial counts of those fleas immediately above and below the median value.

The Indian Plague Commission (*6*) estimated the average stomach capacity of the rat flea, *X. cheopis*, to be 0.5 mm³. In the present study, the determinations made both by weighing the fleas and by counting the bacteria in them immediately after feeding show that the male has a greater body density but a smaller stomach capacity than the female *X. cheopis* (Table 1).

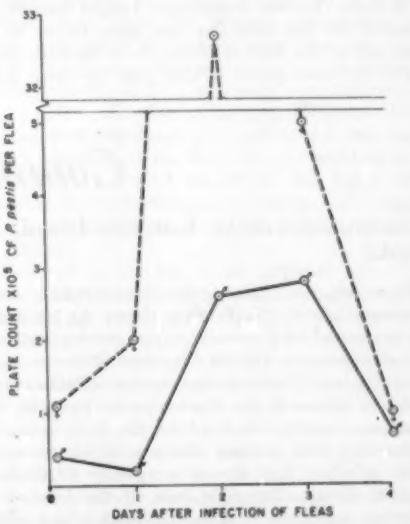

Fig. 1. The median *P. pestis* count in infected *X. cheopis* during the first 4 days after the infectious meal (each point represents the median of five fleas per sex).

Table 1. Numbers of *P. pestis* (avirulent strain A1122) and quantity of blood ingested by *X. cheopis*.

Fleas	Weight* (mg)	Blood vol. ml × 10^{-4} (calc.)†	Bacterial count‡ × 10^4 (actual)	(calc.)
Unfed ♂ ♂	0.30			
Fed ♂ ♂	.40	0.9	5.7	6.5
Unfed ♀ ♀	.27			
Fed ♀ ♀	.42	1.4	10.1	10.1

* Weights of fleas, average of 50 per sex; 1.0×10^{-4} ml blood meal weighs 0.1068 mg and contains 7.2×10^4 plague bacilli.

† Calculated on basis of average weight of blood ingested.

‡ Bacterial counts of fleas based on average of five per sex.

The calculated minimum concentration of plague organisms necessary to infect *X. cheopis* has been estimated at 10,000 bacilli per milliliter (*6*). With the avirulent plague strain used in the present experiments, a much higher concentration is necessary to establish successful infection in fleas. In an early test when a blood meal containing 400 million bacilli per milliliter was given to the fleas all the fed insects initially harbored bacteria. After 5 days, however, only two fleas out of 32 yielded microorganisms when they were macerated and cultured. When the bacteria count of the blood meal was increased to 720 million or more, more than 80 percent of the fleas remained infected with plague for more than 5 days.

Definite proventricular blocks associated with empty and constricted stomachs occurred as early as the second day after the infectious meal, but the rate of blocking did not attain 30 to 40 percent until after 6 to 9 days. Typical ventricular plague masses were observed on the third day and were found in more than half of the fleas examined from the fifth day on.

The *P. pestis* strain A1122, used for these studies, was tested before and after its use in infecting fleas and was found completely avirulent. The white rats, on each of which 60 or more infected fleas fed continuously for 15 days, showed no ill effects. Studies are in progress to challenge the immunity of these animals.

As expected, these preliminary results do not demonstrate any change of virulence after one passage in the flea, but they do establish the fact that a completely avirulent strain of plague multiples forms typical plague masses, and produces proventricular blocks in *X. cheopis* identical to those produced by virulent strains of plague. The blocking of the fleas appears to have a threshold requirement of concentration of microorganisms. This requirement, which may be different for each sex, has not been established, and it is also uncertain whether the quantity of bacteria would have any relationship to the virulence of different strains of plague. Furthermore, it is not known whether other bacteria and other avirulent plague strains will behave similarly to strain A1122 in the flea. These and other problems are now under investigation and will be reported in detail elsewhere.

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9 September 1954.

Communications

Echinococcosis on St. Lawrence Island, Alaska

Parasitological investigations undertaken on St. Lawrence Island (North East Cape) during part of the summer of 1954 revealed a high incidence of alveolar echinococcosis. Of 198 field mice *Microtus oeconomous* Pallas, *Clethrionomys rutilus* (Pallas) examined, 33 harbored the *Echinococcus* parasite. Such infections, usually confined to the liver, ranged in appearance from a focus that was barely perceptible to an infection that almost completely filled the abdominal cavity. The right lobe of the liver of one *Microtus* contained multilocular cysts whose over-all dimensions are 40 mm in length by 25 mm in width. In another *Microtus*, the entire body cavity was nearly filled with cystic formations. The cysts, aside from infecting both the right and left lobes of the liver, were scattered throughout the intestinal mesenteries and over the stomach and heart surfaces.

Two of 12 ground squirrels *Citellus undulatus* (Pallas) were infected with *Echinococcus*. In one of these animals, a massive infection had destroyed three-fourths of the right lobe of the liver. The general appearance of the multilocular cysts in ground squirrels differed only slightly from that in field mice, being somewhat whiter and with larger (3 to 6 mm) and less granular individual cysts. Of four shrews *Sorex jacksoni* (Hall and Gilmore) examined, one was heavily infected with *Echinococcus*. The appearance of the cystic formations in this animal was similar to that observed in field mice.

We have been unable to find records in the literature of alveolar *Echinococcus* occurring naturally in

shrews or ground squirrels. Foxes *Alopex lagopus* (Linnaeus) harbored mature cestodes of the genus *Echinococcus*. Of six hosts autopsied, four were infected with this parasite. The general appearance of the cestodes suggested that they may be *E. granulosus*; however, confirmation of this must await further study, both microscopic and experimental.

Observations on the incidence of echinococcosis in field mice on St. Lawrence Island suggest that the infection becomes well established in its hosts long before macroscopic diagnosis is possible, and that for a true incidence of infection the livers of such hosts must be sectioned and studied histologically. Such a study of 198 livers collected on St. Lawrence Island is now in progress. Dog and fox feces from infected animals are being studied under tundra conditions as to their viability. Immunity and pathological effects on hosts are being made. It is hoped that a more comprehensive report on host-parasite relationships can be given at a later date from the series of experimental infections now in progress with the St. Lawrence Island form of *Echinococcus*.

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3 November 1954.

Abbreviation of Bacterial Generic Names

Probably because they have become accustomed to writing on small surfaces, such as test tubes and ¾-in. labels, bacteriologists often use some form of "laboratory shorthand," and when writing scientific papers continue this practice. Thus the convention seems to have grown up that in the binomial of a bacterial name, the first, or generic, name should be abbreviated. Fifty years ago this was of little consequence, because all rod-shaped bacteria were placed in the genus *Bacillus*, and the abbreviation *B.* was universally adopted. However, in the last forty years there has been a gradual, but ever-increasing, revolt against the *Bacillus* system of classification and nomenclature and a greater splitting of bacteria into different genera. As new names were coined, bacteriologists abbreviated them, usually into the form using the initial letter, thus *Corynebacterium* became *C.*, and this system worked well in papers dealing with bacteria of only one genus or of several genera beginning with different letters.

Authors of textbooks had a more difficult problem, because it was obviously desirable that an abbreviation used in one chapter should have the same meaning when it was used in another chapter. Ford, in his *Textbook of Bacteriology* (1927), usually spelled out the generic name, although in the descriptive sections the *B.* form was used occasionally. The nine-volume *System of Bacteriology*, published in 1929–31 for the Medical Research Council, avoided all taxonomic issues, and used the *Bacillus* system of nomenclature. Topley and Wilson, however, in their textbook made a serious attempt to have distinctive abbreviations for generic names, abbreviations that are fairly widely, but not universally, used by scientific journals in England. The extension of such a system outside the medical field seemed to be a logical step, and the problem was to see whether an extension was possible.

Distinctive abbreviations. The index of edition 6 of Bergey's *Manual of Determinative Bacteriology* was used as a source of generic names, but names used for viruses (pp. 1127–1286) were excluded. A few names proposed since 1948 have been added, but the additions do not materially affect the results. Ideally the abbreviations should be distinct from similar abbreviations used in algology, mycology, and protozoology (for example, *E. coli* might be used for *Escherichia coli* or for *Entamoeba coli*), but the problem has been kept as simple as possible by restricting it to bacterial generic names.

The first few letters make a convenient short form, as *Staph.* for *Staphylococcus*, but they are not always without ambiguity; for example, *Strep.* or *Strepto.* might be used for *Streptobacillus*, *Streptobacterium*, *Streptococcus*, *Streptomyces*, or *Streptothrix*, and *Str.* could be used for all these and for *Streptus*. There are 28 prefixes common to three genera, 17 common to four genera, four common to five genera, seven common to six genera, and 24 common to seven or more genera; the maximum is the prefix *Thio-*, which is common to 27 genera.

So far the analysis has shown that both initial letters and prefixes make ambiguous abbreviations, but we have ignored the specific epithet, which would, in certain cases, make the generic abbreviation clear. Thus *S. typhi* or *S. typhosa* would be clear because, *up to now*, the specific epithets *typhi* or *typhosa* have not been proposed for a species of any other bacterial genus with a name beginning in *S.* However, it would be foolish to suppose that no author will ever propose a new binomial of the form *S. . . . typhi* or *S. . . . typhosa*. In a similar manner *E. coli* has a definite meaning to a bacteriologist but, because of *Entamoeba coli*, is ambiguous to a clinical pathologist or to a physician.

It would be possible to use different letter combinations as short code designations for generic names, but there are so many disadvantages that the scheme would not work in practice. It would be essential to set up an international code-letter registration board so that the same code letters would be used for only one genus. Each editor and every reader would need a key to the code letters, or the generic names and codes would have to be an essential part of each paper.

Questionnaire to editors. Most journals have definite policies on abbreviations for weights and other measures, and some have approved short forms for generic names. I was asked by one editor if it would be possible to have an agreed list of abbreviations for bac-

terial generic names used in conjunction with a specific epithet. To ascertain whether this desire was general, I addressed a letter to the editors of 77 English-language journals and asked each to complete a questionnaire and to amplify his answers when necessary. The editors of *Nature* kindly published a note inviting others interested in the problem to write to me. Replies have been received from the editors of 65 journals. The questions asked them and their answers follow.

1) Do you insist that the generic name be written in full when it is first used? Yes, 57; no, 6.
2) May generic names subsequently be abbreviated? Yes, 62.
3) When abbreviations are allowed, which form is used? Single letter, 29; author's choice, 15; set of approved abbreviations, 18.
4) Do you issue a set of instructions to authors? Yes, 33.
5) Do you encourage the use of common names where these are unambiguous? Yes, 28; no, 16.
6) Are you in favor of attempting to standardize abbreviations? Yes, 52; no, 4; doubtful, 3. In favor of standardizing at the international level, 34; first in the English language, 27.

Analysis of the replies failed to show any significant difference in the views of editors in different countries; nor was there much difference between journals devoted to medical or nonmedical sciences. Generally, medical journals give more freedom of choice about abbreviations to authors, but about half of them issue instructions or suggestions that authors are supposed to follow. Several American medical journals use generic abbreviations given in Dorland's *Medical Dictionary*.

Possible solutions. Many editors sent helpful letters with their replies to the questionnaire, and several stressed the fact that clarity is more important than space-saving. Four solutions are presented for consideration, three of these being in current use:

1) The generic name is written out in full the first time that it is used in each paragraph. The initial letter (without a second letter) is used as an abbreviation on the second occasion that the genus is mentioned in the same paragraph, provided that no other genus with the same inital letter has been mentioned between the first and second naming of the genus in question, in which case the name is again given in full (*Biological Reviews*).

2) The same principle as 1 is applied to each page instead of to each paragraph. But, wherever it would not be obvious which genus is indicated, the generic name is spelled out. (*Annals of the New York Academy of Sciences.*)

3) The same principle applied to each paper; that is, the full name when first mentioned (i) in the title, (ii) in the paper, and (iii) in the summary, with subsequent use of a single (initial) letter for the generic name. Where this would be ambiguous, the name would be written out. (This is the current practice of the editors of 29 journals who replied to the questionnaire.)

4) Do not use abbreviations of generic names, except when a list of species of the same genus is involved, in which case an initial letter abbreviation would be used. This suggestion takes as an analogy the practice of spelling out the long names of organic chemicals, any one of which may occur more than once in a sentence.

S. T. COWAN, *Joint Permanent Secretary International Committee on Bacteriological Nomenclature, National Collection of Type Cultures, London, N.W.9*

18 November 1954.

Conversion of Kynurenine into 3-Hydroxykynurenine in Man

Our finding that hydroxykynurenine is responsible for the diazo-reaction has been confirmed by Dalgliesh and Tekman (*1*), but the route of the formation of 3-hydroxykynurenine from tryptophan in man is yet unknown.

Dalgliesh and Tekman (*1*) suggested that an alternative pathway from tryptophan to hydroxykynurenine might have been involved, possibly via 7-hydroxytryptophan. However, 7-hydroxytryptophan has been synthesized by Ek and Witkop (*2*) and shown not to be attacked by the enzyme system converting tryptophan into kynurenine. This result was confirmed by us by adding liver or kidney homogenate of mice to 7-hydroxytryptophan, which was kindly supplied by B. Witkop.

We have now made the following experiments. When 0.5 to 2.0 g of tryptophan was administered to the urochromogen-reaction-positive but diazo-negative patients suffering from tuberculosis, their urine turned strongly diazo-positive and, on paper chromatogram, the spots of kynurenine and 3-hydroxykynurenine dectectable with diazo reagents became larger and stronger. This fact seemed to indicate that tryptophan is converted into 3-hydroxykynurenine via kynurenine. So we administered kynurenine to the urochromogen-positive but diazo-negative patient suffering from pulmonary tuberculosis and saw that the diazo-reaction of the urine turned strongly positive. On detection by paper chromatogram, the spot of 3-hydroxykynurenine enlarged and became stronger.

The preparation of urine for paper chromatographic detection was done by the procedure already described (*3*). The urochrom fraction thus prepared was precipitated with Hopkins-Cole's reagent. The precipitate was treated with hydrogen sulfide, and the filtrate was concentrated to a sirup under diminished pressure with exclusion of oxygen. This fraction containing 3-hydroxykynurenine was purified by paper chromatography, and identification was effected by comparing with the pure sample of 3-hydroxykynurenine on paper chromatogram using several solvent systems as developer. The results are summarized in Table 1.

Table 1. Rf values of 3-hydroxykynurenine obtained with various solvent systems as developer.

Solvent systems, samples	Butanol, acetic acid, water (4: 1: 5)	Butanol saturated with 1-percent NH_4OH	70-percent isopropanol	Methanol, butanol, benzene, water (4: 2: 2: 2)
3-Hydroxykynurenine fraction obtained from the urine	0.38	0.02	0.30	0.36
Pure 3-hydroxykynurenine	.37	.06	.29	.36

The ultraviolet absorption spectrum of this purified sample was the same as that of pure 3-hydroxykynurenine, showing $\lambda_{max.}$ at 370 mμ at *p*H 7.3, which shifted to 310 mμ at *p*H 1.0. The injection of pyridoxine to the diazo-positive patients did not influence the excretion of 3-hydroxykynurenine in urine (*4*).

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26 July 1954.

Enzymatic Conversion of δ-Amino Levulinic Acid to Porphobilinogen

Porphobilinogen, a compound isolated from the urine of patients with acute porphyria (*1*) has been shown by Bogorad and Granick (*2*) to be converted to protoporphyrin by colorless extracts of *Chlorella* cells. This experiment signifies that enzymes carrying out the conversion of porphobilinogen to protoporphyrin are water-soluble and, thus, that the individual enzymes ought to be amenable to the customary procedures of isolation. Porphobilinogen can also be converted to protoporphyrin by hemolyzates of chicken and red blood cells, as was shown by Falk, Dresel, and Rimington (*3*), and we have confirmed this finding. On the basis of these experiments, porphobilinogen may be considered to be the natural monopyrrole precursor of protoporphyrin.

The precursor of porphobilinogen itself appears to be δ-amino levulinic acid, a compound shown by Shemin and Russell (*4*) to be converted to protoporphyrin by duck erythrocytes. We have found that δ-amino levulinic acid is converted to porphyrins by extracts of *Chlorella* cells, by extracts of spinach, by a strain of *Tetrahymena geleii*, and by extracts of chicken erythrocytes.

Dresel and Falk (*5*) have recently observed the conversion of δ-amino levulinic acid to porphobilinogen by hemolyzed chicken erythrocytes. Recently we have obtained an extract from chicken erythrocytes that converts δ-amino levulinic acid to prophobilinogen. From washed erythrocytes, which have been hemolyzed with water and the hemoglobin denatured with $CHCl_3$-ethanol, a filtrate has been obtained that contains the active enzyme. This aqueous extract is almost colorless. Furthermore, alkaline extracts of the residue contain enzymes that convert porphobilinogen to porphyrins.

The enzyme in the aqueous extract sediments in the ultracentrifuge somewhat more rapidly than does hemoglobin. It may be separated from the accompanying ferritin by starch electrophoresis and appears to be colorless. No appreciable loss of activity accompanies dialysis, so that no loosely bound coenzyme appears to be involved in its activity. Its maximum activity is at *p*H 6.5. The enzyme preparation is somewhat unstable, half of its activity being lost in a week at icebox temperature. Activity is likewise lost during starch electrophoresis in Veronal buffer. In one preparation, δ-amino levulinic acid was observed to be converted to porphobilinogen to the extent of 90 percent of the theoretical as determined with the Ehrlich reagent. The porphobilinogen thus formed has an R_f value in a butanol-acetic-water mixture identical with crystalline porphobilinogen.

The condensation of two molecules of δ-amino levulinic acid to form porphobilinogen requires that two bonds be formed (Fig. 1), a carbon-carbon bond at *A* and a carbon-nitrogen bond at *B*, with the simultaneous removal of two water molecules. One might therefore consider that two enzymes may be involved in this condensation. This does not appear likely since the activity of the enzyme was found to be directly proportional to its concentration through a tenfold dilution of the enzyme preparation. Starch electrophoresis indicated one peak of activity, likewise suggesting that only one enzyme was involved. Whether one enzyme simultaneously brings about the aldol condensation at *A* and the ketimine condensation at *B* remains to be determined. However, since enzymes in general appear to have only one specific activity, it

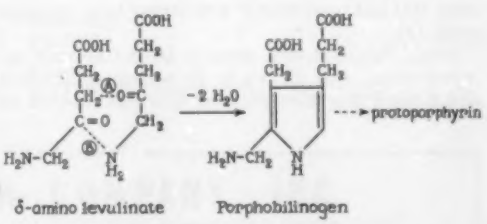

Fig. 1. Structure of porphobilinogen.

would seem more likely that the enzyme catalyzes the aldol condensation at *A*, and that the ketimine condensation then occurs spontaneously at *B*. It may be well to defer naming the enzyme until the specificity of its action has been better defined.

Summary. An enzyme has been found in extracts of chicken erythrocytes which converts δ-amino levulinic acid to the monopyrrole porphobilinogen. Some of its properties have been described (*6*).

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6. We wish to express our gratitude to H. Kunkel, for the starch electrophoresis determinations, and to J. R. Dice of Parke, Davis & Co., for a generous supply of δ-amino levulinic acid.

12 November 1954.

Natural Antioxidants of *Hevea* Latex

Several attempts have been made to identify the constituents of *Hevea* latex responsible for the resistance of raw rubber to oxidation. The most recent of these was that of R. F. A. Altman (*1*) who gives references to earlier work.

No single compound has been clearly shown to be an antioxidant. Altman and others have concluded that protein fragments give some protection against oxidation. Altman, however, found the highest antioxidant activity in an unidentified water-soluble fraction containing no nitrogen.

It is well known that the antioxidant remains in the aqueous phase in ammonia-preserved latex and can be removed by repeated dilution and reconcentration of the latex. The recent observation by M. W. Rider that the antioxidant activity can be removed from latex by a strong base exchange resin (*2*) suggests that the water-soluble fraction obtained by Altman contains an acid (or acids). This suggestion was tested by determining the effect of crude fractions from the serum of a commercial latex on air oxidation, when they were added separately to a sample of the latex that had been treated with strong base exchange resin (*3*).

Latex, stabilized with Antarox D100 (the resin removes soap), was diluted to 20 percent total solids and divided into three portions. One was reserved as a control. The second was passed twice over a column of freshly regenerated strong base resin (Dowex 2), removing serum acids and amino acids. Rubber-free serum was obtained from the third by creaming with 0.15 percent Superloid (ammonium alginate).

Table 1. Viscosities after 17 hr at 110°C.

Rubber from	"Gel" (%)	Intrinsic viscosity
Untreated latex	10	3.21
Dowex treated (A)	4	1.44
A + acid fraction	13	2.75
A + amino-acid fraction	21	2.54
(Unoxidized rubber	7	5.00)

Protein was removed from this serum by adjusting to *p*H 4 with a strong acid resin (Dowex 50) and filtering. Amino acids were collected on a column of Dowex 50, other acids on a weak base resin (Amberlite 1R45).

The 5 percent ammonia eluates from the columns were added to separate portions of the resin-treated latex to give the same concentration originally present. Oxidation resistance of each mixture was determined by spreading 10 ml of the latex in a petri dish, heating in a circulating air oven at 110°C, and measuring intrinsic viscosity of the rubber in chloroform. The results are shown in Table 1.

Strong antioxidant activity is associated with the acid fraction. This has been shown to consist largely of plant acids (*2*). C. E. Rhines (*4*) has presented good evidence that the ease of oxidation of raw crude rubber from which natural antioxidants are removed depends on transition elements, always present in small amounts. Their effect on oxidation is strongly inhibited by the powerful chelating agent, ethylene bis (iminodiacetic) acid. Plant acids apparently have the same function, although they are less efficient. This may explain an earlier observation (*5*) that the rate of oxidation of ammonia-preserved latex decreases with age of the latex. Fresh latex contains little free acid. Hydrolysis of the esters present causes it to appear slowly on storage.

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Meetings & Conferences

February

4–5. American Geophysical Union, Berkeley, Calif. (D. K. Todd, College of Engineering, Univ. of California, Berkeley 4.)

7–9. Conf. on Silicosis and Occupational Chest Diseases, Saranac Lake, N.Y. (N. R. Sturgis, Jr., Saranac Laboratory, Saranac Lake.)

7–11. American Soc. of Civil Engineers, San Diego, Calif. (W. N. Carey, 33 W. 39 St., New York 18.)

8–9. Midwest Welding Conf., Illinois Institute of Technology, Chicago. (Mel Garbar, Illinois Institute of Technology, 35 W. 33rd St., Chicago 16.)

11–25. Pan American Acad. of General Practice, Lima, Peru. (A. Martinez, 54 E. 72 St., New York 21.)

13–17. American Inst. of Mining and Metallurgical Engineers, annual, Chicago, Ill. (E. H. Robie, 29 W. 39 St., New York 18.)

14–16. Nutrition of Plants, Animals, Man. Michigan State College, Centennial Symposium, East Lansing. (Continuing Education Service, Kellogg Center, Michigan State College.)

14–19. Latin American Cong. of Physical Medicine, Lima, Peru. (C. L. de Victoria, 176 E. 71 St., New York 21.)

17–18. National Conf. on Transitor Circuits, Philadelphia, Pa. (W. J. Popowski, Minneapolis-Honeywell Regulator Co., 176 W. Loudon St., Philadelphia 20.)

17–19. American Acad. of Forensic Sciences, Los Angeles, Calif. (W. J. R. Camp, 1853 Polk St., Chicago 12, Ill.)

28–1. American Orthopsychiatric Assoc., 32nd annual, Chicago, Ill. (M. F. Langer, AOA, 1790 Broadway, New York 19.)

28–2. American Educational Research Assoc., St. Louis, Mo. (F. W. Hubbard, 1201 16 St., NW, Washington 6, D.C.)

March

3–4. American Assoc. of University Professors, Gatlinburg, Tenn. (R. E. Himstead, AAUP, 1785 Massachusetts Ave., NW, Washington 6, D.C.)

7–9. Chemical Inst. of Canada, Divisional Conf. of the Chemical Engineering Div., Ottawa, Ont. (W. M. Campbell, Box 323, Deep River, Ont.)

7–11. American Soc. of Photogrammetry, Washington, D.C. (C. E. Palmer, 1000 11 St., NW, Washington 1.)

7–11. National Assoc. of Corrosion Engineers, 11th annual, Chicago, Ill. (A. B. Campbell, 1061 M & M Bldg., Houston 2, Tex.)

14. American Educational Research Assoc., Denver, Colo. (F. W. Hubbard, 1201 16 St., NW, Washington 6, D.C.)

14. Wildlife Soc., Montreal, Canada. (D. L. Leedy, Fish and Wildlife Service, Washington 25, D.C.)

15–17. Electrical Utilization of Aluminum, American Inst. of Electrical Engineers, Pittsburgh, Pa. (N. S. Hibshem, AIEE, 33 W. 39th St., New York 18.)

17–19. American Physical Soc., Baltimore, Md. (K. K. Darrow, Columbia University, New York 27).

17–19. International Symposium on Cardiovascular Surgery, Detroit, Mich. (John Keyes, Henry Ford Hospital, Detroit 2.)

17–19. National Wildlife Federation, Montreal, Canada. (C. H. Callison, 232 Carroll St., NW, Washington 12.)

17–2. Inter-American Statistical Conf., 3rd, Santiago, Chile. (IASI, Pan American Union, Washington 6.)

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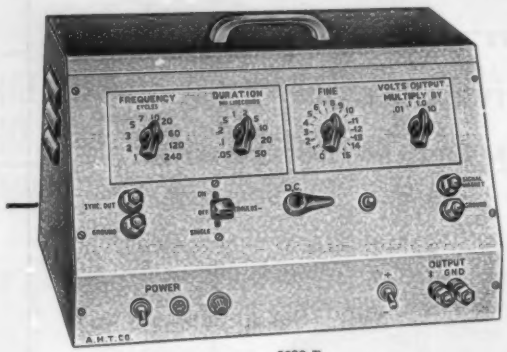

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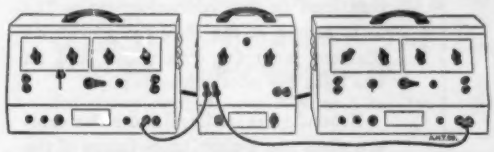

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